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ABSTRACT

This document consists of the three issues of the journal "Design & Technology Teaching" for the 1994-95 publishing year. This journal focuses on developments in design and technology across all phases of education. It provides a forum for sharing and developing expertise in all the contributing areas of design and technology: art and design, business studies, home economics, and information technology. It covers news, information, reviews of materials and resources, and case studies of good practice. Regular departments also include instructional technology, teacher education, and curriculum development. Although lesson plans are not included in every issue, most articles are accompanied by photographs of exemplary student work. (DQE)

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Secondary vol. ISBN 1898788 014 (members £17.95) £19.95
An authoritative guide to help you plan and deliver design and technology. Over 300 resources categorised in such a way that you can match any changes in the technological course proposals. Lists books, software, videos, equipment, tools and places to visit. Easy to use — well structured and detailed, helping you benefit from the experience of others. Ensures that the right resource is purchased for the right activity.

DITT Pack

IT in D&T pack £19.50
The DITT pack is a set of adaptable classroom resources aimed at encouraging the use of IT within the framework of National Curriculum D&T. The pack is interactive and contains a wide range of tasks, each produced on separate photocopiable sheets and featuring basic IT skills. By selecting from these materials, teachers can build a programme of activities to suit pupils of widely differing needs and abilities.

All the activities have been written by teachers for practical use in the classroom. Each is clearly presented and makes use of familiar materials and equipment. All that is new is the incorporation of IT. The materials can be used with a whole class or a small group of individual pupils, and are suitable for a wide age-range, but most specifically Key Stage 3.

A Survey of Capitation Allowances for D&T in Primary and Secondary Schools

DATA Research Paper No. 1 £3.50
Looks at the implementation of D&T in the National Curriculum, specifically at the criteria for allocating capitation allowances and the variations which exist. Directly associated issues which affect the satisfactory implementation of design and technology are also addressed.

A Survey of the Qualifications and Training needs of D&T Teachers in Secondary Schools

DATA Research Paper No. 2 £7.50
This is a report on the training and qualifications of teachers of Design and Technology in secondary schools in England and Wales, based on a survey of several hundred schools. The survey was carried out to examine the relationship between the qualifications of Design and Technology teachers in secondary schools and the elements of D&T they were currently teaching.

Imagineering

ISBN 0 948080 84 1 £3.50
Imagineering presents an exciting way of stimulating young people to develop creative ideas in design and technology and to go on to put them into practice. The ideas developed in it are the result of a collaborative project between schools and manufacturing companies in Keighley.

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Design & Technology Teaching©

A journal of new approaches

Volume 27 Number 1 1994

A journal of DATA, The Design and Technology Association

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Design & Technology Teaching is published three times a year — Winter, Spring and Summer.

The journal focuses on developments in Design and Technology across all phases of education. It provides a forum for sharing and developing expertise in all the contributing areas of design and technology: art and design, business studies, CDT, home economics and information technology. It covers news, information, reviews of materials and resources and case studies of good practice. Design & Technology Teaching is distributed free of charge to members of The Design & Technology Association.

Contributions Contributions are welcomed, and prospective authors are invited to send a synopsis of their article to the Editor, Design & Technology Teaching, DATA, 16 Wellesbourne House, Walton Road, Wellesbourne, Warwickshire CV35 9JB.

Reviews Books and resources submitted for review should be sent to the Editor, at the address above.

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Editorial

John Eggleston

The deadline for submissions on the latest draft orders is now passed. SCAA has received many hundreds of lengthy documents — including, of course, one from DATA on behalf of its members. SCAA has now gone into retreat and will deliver the new orders, ready for parliamentary approval, by the end of the year. Schools will receive them in January 1995.

One of the main issues has been the role of food as a material. DATA is unambiguous in seeking the retention of food, arguing that it should be required rather than optional at Key Stages 3 and 4. The well publicised argument against food, led by the Engineering Council has been a major driving force. But this has now been countered by the Institute of Chemical Engineers' statement. It reads:

> Food technology should be included in the revised national curriculum for design and technology. The professional body for process and chemical engineers objects to the Engineering Council's comments on the proposals for the revised national curriculum. The EngC seems to think that 'food' should be relegated to home economics and dropped from design and technology.
>
> In a response to Sir Ron Dearing, Chairman of the School Curriculum Assessment Authority, IChemE points out the flaws in the EngC view. The EngC seems to be confused between food technology, the processing of food materials on a large or small scale, and the domestic skills needed to prepare food for home consumption. Its comments clearly suggest food means the study of home economics. A view IChemE believes is a basic mistake. The inclusion of food allows boys and girls to study the technology of food in its widest sense and not just 'cooking'.
>
> The technologies used in the manufacture of food are diverse and large scale. The process operations involved are common to other processing industries like petro-chemicals, plastics, drinks, agrochemicals, pharmaceuticals and many more. Therefore food should be an important component of design and technology studies.
>
> A good understanding of technology is needed to manufacture food. Compared to other materials, foodstuffs present even more challenges. Hygiene, texture, taste and changes in state must be taken into account.

Another concern of DATA — the need for a strong emphasis on design — has been reinforced in the evidence of The Chartered Society of Designers. It identifies aspects where the draft proposals 'fall short'.

These include concern that the concept of identifying needs and opportunities has been virtually dropped and that some proposals — including those at Key Stage 3 — are too prescriptive. The society also wants SCAA to place greater emphasis upon cost factors. The Director, Mr Lymbery said: "We recognise that it is difficult for schools to resource themselves, but the work of a designer is now much more computer-based, and we feel the proposals at Key Stage 3 do not reflect how professional designers operate".

These powerful arguments, aimed directly at government, are likely to add considerable weight to the views of DATA and most other teachers' associations.

Meanwhile events at DATA are not suspended until the outcomes are known. Our activities continue to provide ever increasing services to our members. The 1994 Conference at Keele was an outstanding success and is reported by our Chairman, Ray Peacock, in this issue. Membership figures are healthy, foundation and industrial support are also in good shape. Our search for a chief executive has also been successful and a new dynamic appointment will take office in January 1995. We believe he will take DATA forward nationally, regionally and locally to a future in which DATA and its members will occupy centre stage in the preparation of our future citizens.

The task is not easy. Even if a viable, teachable curriculum is achieved the provision of resources still has to be achieved. The shrinkage of local authority provision, the closure of teachers' centres and their resource collection and the recent reduction of the Design Council with the closure of the Design Centre and its library place an even greater responsibility on DATA to deliver mentor support. We intend to ensure the quality support that our key sector of the profession must have if it is to fulfil its role effectively and fully.

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News and Notes

Technology on TV this autumn

Channel 4 Schools has two technology series this term for Key Stages 3 & 4:

The Technology Programme (Tectactics for KS3 — starting 21st September) and Packaging (KS3/4 — starting 23rd November)

*Mind Your Own Business (*KS4 — starting 16th November)

Programmes for younger pupils include:

Fourways Farm (KS 1 science and technology — Tuesdays 10.00)

Stage One (KS 1, including topics on materials and toy technology — Tuesdays 11.22)

Junior Technology (KS2 designing and making — Mondays 11.45)

Design Council Changes

The Design Council has announced that it has appointed Wendy Powell as interim manager of its new Education and Training Foundation. Currently head of design management at De Montfort University, Wendy Powell will be working for the Council on a part-time basis for six months. The Design Council Bookshop is to be taken over by Zemmers and moved to shops at 24 Litchfield Street and 80 Charing Cross by mid-October.

GNVQ centres grow

City and Guilds reports that 954 centres will be offering GNVQs this academic year, teaching an estimated 53,000 students. Predicted student numbers include:

Foundation Level:	
Art & Design	1500
Business	4000
Manufacturing	1000
Intermediate/advanced:	
Art & Design	4500
Business	13000
Manufacturing	3000
Built environment	400
Hospitality & Catering	700

Two pupils of Guilsfield Primary School with their sensor-activated drawbridge, designed for Control Techniques' Technology Challenge. On approaching the bridge, boats pass a sensor which triggers the traffic lights, sounds an alarm and opens the drawbridge.

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British Brains Behind Flintstones

Flintstone fans may like to know that the dinosaurs in the Flintstones film were controlled by a 32-bit ARM processor designed by MicroRobotics of Cambridge. Creatures such as Dino contained as many as 20 remote-controlled motors to activate eyes, lips, jaws, ears and limbs. Perhaps the new technology curriculum will include dinosaurs amongst the design and make tasks.

Call for Papers

The IEE is inviting papers for the fifth IEE Conference on Telecommunications, to be held in Brighton in March 1995. Authors may address any aspect of telecommunications as a technology or industry. Contact IEE (tel. 071 240 1871) for details.

The Food War continues . . .

The temperature is rising in the Food War between the British Nutrition Foundation and the Engineering Council. A recent press release from the BNF, entitled 'Food Technology and the Hard Hat Brigade' says that there is ample scope for compromise 'if the Engineering Council would give up its bigotry. If it won't then Sir Ron and his colleagues at SCAA must look very hard for the clothes on this pretender to the technological throne'.

ACITT Awards

The Lego Dacta Control Lab was voted best peripheral by members of the National Association for Co-ordinators and Teachers of IT in July. Favourite educational computer was the Acorn A3000 and most valuable software package was Longman's Pinpoint.

Tyne & Wear Museums

Shipley Art Gallery, Gateshead: 'Made in Gateshead — Industry, people and skills', a new permanent exhibition; 'High Table', a display of contemporary domestic ceramics (until 30th October) Newcastle Discovery: 'Superbike' — the secrets of the bike that won the speed trials in the 1990 Olympics (until 12th November) South Shields Museum and Gallery: 'The World of Toys' (until January)

New Products

- EFM Flamefast has a new brochure featuring heat equipment for D&T; ring 061 793 9333 for a copy.
- Power Adhesives has launched a new low-melt adhesive with an improved glue gun (details on 081 507 8433)
- The Aluminium Can Recycling Association has produced a new 10-minute 'fun' video on the importance of recycling, available on loan from ACRA (tel. 021 633 4656)
- Micrografx has launched Designer 4.1 Technical Edition, which 'allows everyone to draw and edit illustrations in a CAD environment at any stage of the design process'. Windows based, it costs £375; details on 0800 626009.
- The Health and Safety Commission has updated *Safety Policies in the Education Sector.* It costs £5 and is available from HSE Books, PO Box 1999, Sudbury, CO10 6FS, Dillons and Rymans
- Berol is adding two new colours to its Pearlescent Cromar Paint range: Midnight Blue and Candy Floss Pink; sets of all ten colours are available at £19.50 plus VAT

Events

Until 16th October
Ceramics by Walter Keeler: Crafts Council (071 278 7700)

Until 13th November
'2010' exhibition — Textiles and New Technology: Crafts Council

14th Oct. — 24th April
'It's Plastic!' at the Design Museum (071 403 6933)

14th Oct. — 14th Jan.
'In Context Project' featuring textiles and fashion work in plastic and synthetic materials: Design Museum

18th Oct. — 20th Nov.
Textiles by Nicola Henley and metalwork by Michael Lloyd: Crafts Council

2nd — 3rd November
TIFCON 94, Blackpool, conference on floor coverings: Textile Institute (061 834 8457)

10-12th November
D&T Exhibition, NEC, Birmingham

17th November
'Nutrition Labelling', half-day course by BNF (phone 071 404 6504 for details)

23rd Nov. — 23rd Dec.
New works for Christmas: Crafts Council

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Annual Conference 1994, Keele, Management of Change: Challenges and Opportunities

Ray Peacock

Chairman, DATA

A successful conference has four key ingredients. Firstly, it must be clear why you're there: what are its aims and what sort of outcomes can be expected? Secondly, good, useful information must be conveyed, advice given and ideas exchanged. Thirdly, a convergence of views should take place on which headway can be made and routes identified. Lastly — and by no means least — it should be enjoyable.

The DATA Annual Conference and AGM, held at Keele University at the end of June (thanks to the hard work of the organisers and the support of the DFE, OST and Unilever, and the positive attitude of the delegates and contributors) was remarkably successful on all four counts.

The aims of the 'Management of Change: challenges and opportunities' conference were:

— to consider the numerous support initiatives and the perception of parties interested in the field of D&T, and devise a strategy for maximising collaboration between them to the benefit of the profession

— to illustrate 'quality' and suggest ways to further enhance and value this attribute.

Information concerning current initiatives came from papers given by some dozen agencies, including HMI, SCSST, UBI, BA, Nuffield, SCIP, RCA and TEP. Further details of schemes and initiatives were made available throughout the conference from a large number of exhibitors representing almost all of the major players. SCAA presented two papers concerning Proposals for Change (KS1 & 2 and KS3 & 4) and OFSTED gave valuable advice on preparing for, and getting value from, inspection.

The disturbing facts which have emerged from the two major DATA Research Papers published recently (*Survey of Capitation Allowances for D&T in Primary and Secondary Schools* and *Survey of Qualifications and Training Needs of D&T teachers in Secondary Schools)* were put forward as another contribution to the conference information pool.

With so much information, knowledge and analysis in our heads, the process of synthesising strategy and actions had now to start. Keynote papers on 'The Way Ahead' by Mike Ive HMI and 'An Active Role for Industry and Commerce in Developing a Professional Teaching Force' by Alan George of Unilever set the scene for delegates to attempt in discussion groups to synthesise the strategy and actions we would like to see adopted.

One of the most satisfying aspects of the discussions which took place in discussion groups was the convergence of views concerning the most important issues in our profession and the actions which were therefore necessary. They were to:

— establish a clear and shared *vision* of D&T

— develop some *quality assurance* codes of practice

— develop an effective *national medium of communication* to all teachers, agencies and producers.

(The details of these agreed action points are shown below.)

It was rewarding to find that in spite of the wide range of interested parties participating in the conference, there was a consensus that DATA should play a major part as 'honest broker' in co-ordinating the actions to make these things happen. DATA's Executive Committee has taken these proposals on board and significant progress has already been initiated. Members will see an announcement of a project addressing the first of the action points in the next few weeks.

Another major part of the conference concerned the information exchange and discussion which took place in the 22 primary and secondary 'streamed' sessions on classroom/school activities and in the workshops held. It was here that quality in practice and outcome was most clearly evident and these sessions were widely acclaimed for their value to practitioners.

The conference was structured flexibly so that people could attend sessions which were most useful to them and as a result some 380 attendances were recorded over the three days. The setting, facilities and accommodation for the conference and exhibition were ideal, and Keele University is to be congratulated.

Lastly, with delegates representing so many facets of D&T, the support for DATA and the constructive atmosphere of enthusiasm, interest, co-operation, enjoyment and 'buzz' which pervaded the whole conference was very

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encouraging and augurs well for the future of the subject and the focus which DATA can provide to assist all those who are interested in the effective teaching of design & technology.

1994 DATA Conference — Action Points

As a result of structured discussion within five groups, the following summary of action points was presented to the conference under these headings:

— Vision

— Quality assurance

— Communication

Vision

- *DATA should co-ordinate moves to produce a statement expressing the shared vision of design & technology as a defined area within the National Curriculum*

  — There is an urgent need to produce a DATA-Co-ordinated statement which seeks to end the confusion in understanding between education and its partners and also within each group

Action

Bring together sponsors and agencies to reflect on that statement; amend as agreed, but be prepared to 'stand up and be counted'

Action

Based upon that agreed vision, produce a set of targets for action and achievement

Quality Assurance

- *DATA should develop Codes of Practice, with consumer and teacher input, reflecting the original vision and targets. The codes of practice should be applied to:*

  — curriculum materials and support resources (human, technical and other)

  — INSET provision

  — agencies and support organisations

  There was general support for some form of 'kite mark': consumers (both teachers and students) need guidance on quality assurance, given the plethora of initiatives and materials in existence.

  DATA's *Good Technology Guide* was a most welcome innovation, but now needs developing with supplementary services as listed above, and relying significantly on the view of teachers.

Communication

- *A nationally effective medium of communication is needed to reach all teachers, agencies and producers.*

  A vision and targets need to be owned by as wide an audience as possible; there is a great need for DATA to be proactive in promoting itself, its services and its influence.

Action

Set up a 'one-stop shop' telephone answering service: this needs to be accessible to teachers and provide users with information about support organisations and activities in schools; where direct information could not be provided, information on other contracts could be supplied.

Action

Develop local access to advice and support: this needs to be genuinely 'local' since the decline of LEA teacher centres is removing expertise and access to resources.

Action

Produce a simple flow-chart for schools, helping them to find pathways to developing the curriculum, discovering about initiatives and resources; this needs to include those factors which are important in decision-making and also provide information such as contact telephone numbers and addresses.

Action

Apply the vision, targets and codes of practice to a school-created initiative and promote these in the same way.

curriculum support service

Birmingham City Council Education Department

Design Technology

The CSS is Birmingham LEA's principal provider of Curriculum and Professional Development Support for teachers. Detailed below are two examples of our many courses in the field of D & T.

Assessing Design and Technology Activities within Key Stage 2
9.00 - 3.30 - Tuesday 4th October 1994

Designing with Key Stage 3 and 4 Pupils
9.00 - 3.30 - Friday 25th November 1994

For application details & information regarding other courses please contact:
CSS Inset Administration, Martineau Education Centre, Baldeu Road, Harborne, B'ham, B32 2EH.
Tel. No: 021 428 1178. Fax: 021 428 1180. **Please quote reference DT1.**

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Developing a Professional Teaching Force in Design & Technology: an Active Role for Industry and Commerce

Alan George

Education Liaison Manager, Unilever UK

Paper presented to the DATA Conference, Keele University, 23- 25 June 1994

I was invited to give this paper as a result of certain views I discussed privately with members of the DATA Executive about how industry and commerce could do more to support Design and Technology teaching in schools, particularly through helping teachers of D&T develop their professional standing.

My views are based on my ten years' experience of managing Unilever's involvement with education; the understanding this has given me of both the politics of education and the realities of life in schools; and my and my company's particular interest in Technology. My personal mission with regard to education is best described as *'seeking to bridge the gap between rhetoric and reality'*.

In the area of Technology education, as you know, that gap is still considerable and gives great cause for concern. And those of us who are interested in ensuring that every child has access to a quality Technology education need to work hard and, I would argue, *collaboratively* — to close the gap.

■ World Class Technology

I start with the thesis:

1. If the UK is to have world-class technological skills we need to make Technology teaching in our schools world class too.
2. We cannot have world class teaching without a properly trained and well-motivated teaching force.

In the Technology area, clearly such a teaching force does not yet exist.

It is worth pointing out that the CBI has already taken a lead in identifying teachers as the key element of its strategy for achieving the 'Skills Revolution'. The CBI has further observed, with some concern, that issues surrounding teaching quality and training, particularly the need for national standards, remain unresolved.

■ Industry's Role

There is no doubt that industry generally is interested in working with education. Indeed, interest has never been greater, and this is a result of concerns about the availability of technological skills, our international competitiveness, and also a deeply felt desire by many industrialists to see that young people are equipped to make their way in a world where available jobs will require higher skill levels.

There is not time to catalogue the help that industry already gives Technology education, or how it could help further. It is enough to say first that industry is uniquely placed to help because it has the relevant knowledge and expertise; and schools need industry's support if they are to provide a modern and challenging curriculum. And second that manufacturing industry, in particular, has a considerable self-interest in seeing more young people developing technological skills as a basis of careers in industrial design, technology and engineering.

Instead I want to focus on the barriers which are preventing companies from doing more and how we can remove those barriers.

There are five main constraints in my view.

The first is in a different category from the others. We need to be aware that schools — urged by Government — are making increasing demands on business. And they are doing so at a time when we are just coming out of recession (I think!), and are experiencing structural changes which are putting more and more pressure on fewer and fewer employees within companies.

We have to ensure, therefore, that demands on business are well thought out, reasonable and cost-effective. This is critical in the case of Technology because here we need a step-change in business involvement. Indeed, it could be our last chance to get it right in this decade.

Other constraints are:

- Confusion over the definition of Technology
- Ambivalence in Government policy on Technology education
- Confusion over the multiplicity of initiatives
- General ignorance within business about the actual state of Technology education in schools.

I will say a few words about each.

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What is Technology?

We start from a poor position since many people in business regard Technology as the practical application of Science rather than a discrete, holistic area of study concerned with 'designing and making'.

Business has been confused by the various proposals during the last few years to change the scope of National Curriculum Technology and, as you know, the situation is still not resolved. Since teachers are also confused, you can imagine the position of people in business, most of whom have no detailed understanding of the workings of education. An example close to home is the uncertainty over the role of food in National Curriculum Technology. Unilever is one of the country's leading food manufacturers and could be expected to help support the teaching of food technology in schools. However, we are not convinced we should commit major resources of money and people's time to supporting food technology in schools if its place in the curriculum is uncertain.

Government ambivalence

Like those who have to teach Technology, business people are also bemused by the inconsistencies in the Government's policies on Technology education. National Curriculum Technology, as I understand it, was conceived as a foundation subject — *that is an entitlement for all pupils* — and still has that status legally.

As we know, the standard of Technology education which any pupil receives mainly depends on the priority Technology has in the school's curriculum, the dedication and skills of the teachers involved and the resources available for accommodation, equipment and materials.

Government funding currently favours institutions providing Technology as a *specialism* and who are prepared to become '*grant maintained*'. This is neither in the spirit of the National Curriculum nor an effective use of resources. Furthermore, many companies wanting to support Technology in schools will not give support if it can be construed as party political, which is the case with the City Technology Colleges and Technology Colleges programme which is linked to the GM movement.

The Government has yet to provide a credible explanation of how specialist Technology Colleges equate with Technology as a National Curriculum foundation subject, and how its policy of specialisation serves the national interest. This raises serious doubts about the Government's commitment to improving the quality of Technology education universally.

The vast majority of Technology teachers, of course, are outside the CTC/TC programme. When they see the funding disparities, we should not be surprised if they think the Government regards them as 'second class citizens'.

Multiplicity of Initiatives

Many business people find the education system confusing and this often deters them from becoming involved. The Technology area is particularly confusing.

There is a surprising number of initiatives which either have Technology in their title or support Technology education in some way. We have CTCs, TSI, Technology Colleges, TVEI, DATA, SCSST, SATROs, CREST, NCET, TEP, NDTEF, the Design Council, RCA, Young Engineers, Young Engineers for Britain, Neighbourhood Engineers, and so on. With all these initiatives, we should not be surprised therefore if people in business get the impression that Technology in schools is well supported. Of course, teachers from their position see it differently.

Greater coherence would be helpful all round.

The Actual state of Technology teaching in Schools

Most industrialists would be alarmed if they knew the true state of Technology education in the nation's schools. However, they need to be told the facts and I'm sure this would spur them to action.

Later in the programme, Gordon Warren, will be reporting the results of the DATA surveys of Capitation Allowances and Teacher Training Needs in the Design and Technology area. Without wanting to steal his thunder, I am going to quote some of the main findings from the survey reports.

In the Primary schools surveyed, the average annual allowance per pupil for D&T work is £2.40 from a range which varies from £0.04 to £12.76. While in the Secondary schools the average per capita allowance for D&T is £5.19, from a range which extends from £0.82 to £18.23.

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The average capitation figure for Secondary schools from the DATA survey equates well with OFSTED's earlier findings. You know what £5.19 will buy, but for those in doubt the DATA report explains that such a basic item as one square foot of acrylic sheet with the necessary adhesive would absorb the total per capita allowance for a pupil for a full year. Incredible but true!

I was told by one headteacher that the resources required to implement National Curriculum Technology are about five times those required for Science and eight times the average for all subjects.

It is clear from these figures that many schools are failing to provide pupils with their entitlement to a Technology education of a reasonable standard.

Turning to the skill needs of D&T teachers, only 20 per cent of teachers surveyed felt that, overall, they had been adequately trained to teach Design & Technology as required by the National Curriculum. Furthermore, fewer than half had attended a course in the past four years.

This picture is confirmed by OFSTED's report on Technology at Key Stages 1, 2 and 3 for 1992-93, which says 'in about half the schools there was insufficient equipment for D&T and often the range of D&T materials was limited' and 'about two-thirds of the schools needed enhanced accommodation'. And on teachers' skills: 'A great many primary, secondary and SEN teachers need INSET in this relatively new area of the curriculum'.

■ Partnership

Unilever has been involved from the early days in encouraging industry to be actively involved with Technology in schools.

In 1990, when the National Curriculum Technology Order was published, we joined forces with SCSST and the Engineering Council to produce a leaflet aimed at industry. Simply, it said that it is important for industry's future success that the Technology Curriculum is introduced in schools effectively, and that this is unlikely to be achieved without support from companies. We suggested various ways in which companies could help.

The task we face today is as great as it was four years ago; indeed it is probably more complex now because of the loss of confidence among teachers buffeted by apparently pointless change.

I share the view — eloquently expressed by Rhona Seviour, Technology Advisor for Hertfordshire, in her recent article in *Design and Technology Times* — that the state of Technology in Schools is such that nothing short of a 'Marshall Plan' is required to provide what the nation needs.

I am convinced there are enough influential groups and individuals committed to the success of Technology in schools in this country to enable success to be achieved, provided we are prepared to work in partnership. This means putting children, teachers and the national interest first. It also requires strong national leadership and vision.

I believe we need what I am calling a *Partnership Plan for World Class School Technology*. This will need the support of school managements, technology teachers, teacher trainers, government, business, professional bodies, support agencies and those charitable trusts such as Gatsby, Nuffield and Smallpeice who are committed to Technology.

Technology teachers need to:

- organise themselves under a professional body — which I believe should be DATA — and develop a strong voice to promote their interests.
- take ownership of the Technology curriculum
- set minimum standards of accommodation, equipment and teacher skills
- tell Government and business the true state of affairs in schools and what needs to be done to make Technology in UK schools world class.

Government needs to:

- demonstrate by deeds, ie. its funding decisions, that it is committed to raising standards of Technology education universally
- acknowledge that Technology, as a new subject in schools, has special needs
- show leadership in the area of Technology education.

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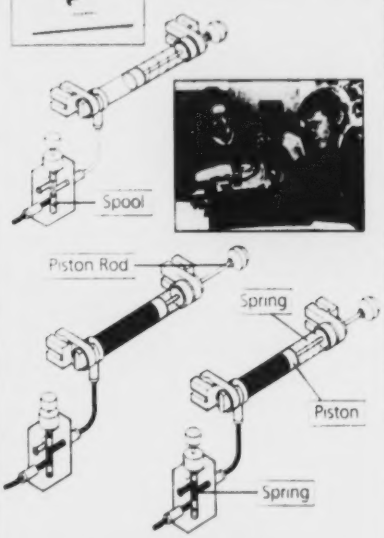

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The professional bodies and support agencies need to:

- co-operate more closely to develop a coherent framework within which they can give schools more targeted help
- engage the active involvement of business.

Business — an Agenda for Action

Finally, here is my agenda for action for the business community.

- Make support for Technology a priority for education involvement. Lead from the top; inform your employees, especially those who are school governors.
- Find out what schools are required to provide under National Curriculum Technology and what are minimum national standards.
- Visit local schools and talk with headteachers and Technology co-ordinators. Find out what provision there is for Technology at the various key stages, and how they compare with minimum national standards.

In particular, look at:

— schemes of work, continuity and progression

— specialist accommodation and equipment

— whether work challenges and stimulates pupils

— equality of opportunity for girls and boys and those pupils with special needs

— use of IT

— investment in the professional development of teachers

- Tell heads what you think of the standard of provision and offer to work in partnership to tackle deficiencies, and to help monitor progress.
- Raise the issues with appropriate local/regional partnership organisations — the Training and Enterprise Council, for example to generate a local plan of action to raise standards and maximise resources available. Consider a consortium approach to make optimum use of specialist equipment and expertise.
- Where there are blockages to progress, raise the issues with your local MP, the DTI, CBI, locally or nationally.
- Devise a company support programme within a local/regional partnership framework

  Consider providing:

  — relevant and challenging activities for pupils

  — placements for teachers focusing on modern technology as a contribution to their professional development

  — employees to work in schools on technology projects alongside teachers

  — access to modern equipment where appropriate

  — consumable materials
- Above all, show you value the work of teachers and applaud achievement by teachers and pupils.

Conclusion

Clearly, there is an enormous job to be done before we can claim that Technology education in UK schools is world class. In conclusion, I want to say I am prepared to play a full part in encouraging the business community to be actively involved in the partnership approach which I believe is required. I see this conference as a vital first stage in bridging the gap between rhetoric and reality and making a dream come true.

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Managing change: the real issue?

Sian Bowen

UBI (on secondment from Marks & Spencer)

I would like to start my brief session by talking about the work I am currently involved in with the UBI National Education Programmes Unit. This will I hope, bring together two themes which are relevant to the Conference, and to you as an audience, whether you are from business or from education.

The first of these themes is collaboration. The Unit has worked for many years now with various major UK and international companies in order to try to communicate the best, and most forward thinking business management practice to those tasked with managing schools. This collaboration has taken the form of management development training, for example, workshops developed and run with Rank Xerox on Total Quality Management and Team Building and Workshops run with British Gas. More recently, conferences, and research into management issues in schools have formed part of the portfolio of Unit activities.

All of this work is founded on the principle, shared by the Unit and its industrial sponsors, that the good management and organisation of the school is a vital part of the delivery of top quality education to young people. In M&S terms, not to accept this basic principle would be akin to saying that it doesn't matter what the environment is like in a store, or how well or badly it is managed, as long as the merchandise is good.

There are lots of opportunities for collaboration between schools and businesses, and many organisations involved in assisting or facilitating working together. I think, in fact, there is a degree of over-supply in the market. The key question is, however, how is the resource spent in both schools and industry being targeted to produce maximum benefit for both parties?

Having spent some time working on this issue with a number of colleagues from Marks & Spencer who are also seconded to work within education, we concluded that there were four valid areas of collaboration with schools and colleges. In curriculum development, in provision of work experience for young people, involvement in careers and guidance within schools, and finally in management development opportunities, properly targeted teacher placements being part of this. This conclusion is one of the elements of a review of education business policy we have recently completed for the Company.

Our conclusions should not come as any great surprise. However, the point I would make here is that the weighting of activity across these focus areas is perhaps not maximising the benefits to either education or business. And I refer here particularly to what seems to be the flood of curriculum materials, that businesses seem all too willing to add to. I refer also to what I see as less well utilised opportunities to look at management and organisational issues and share with industry some of the successes, and some of the problems it has encountered in this area. I think on balance, sharing the problems, slightly more than sharing the successes, is perhaps the more useful aspect of collaboration in this area, so much of which is to do with the management of change, and this brings me to the second theme of this brief presentation.

As a country, and as part of the European Union, we are facing increasing uncertainty, economically, politically and socially, and the trend looks set to continue. There were will be no 'period of consolidation'.

In a business context, decision making is ever more difficult against such a background. The rise of new industrialised economies, the so-called 'Asian Tigers' for example, new industries, and the internationalisation of business all bring new demands, new threats and opportunities. In short, it brings change. It brings change very obviously to business, but no part of society is immune.

Against this background some major, and well known, companies have undergone fundamental changes affecting both numbers employed, structures, and ways of working. The impact of technology, particularly information and communication technologies is an important aspect of this.

This experience is something to be tapped into by educationalists. Understanding what is happening in industry is key to delivering the right messages about the world of work to young people. But there are also opportunities to examine how business organisations are changing, what this means for individuals within the organisation, and to consider what may be culled from such experience and applied to a school or college in order to manage more effectively. A vital part of the process is communication in 'the other direction', in getting business to understand

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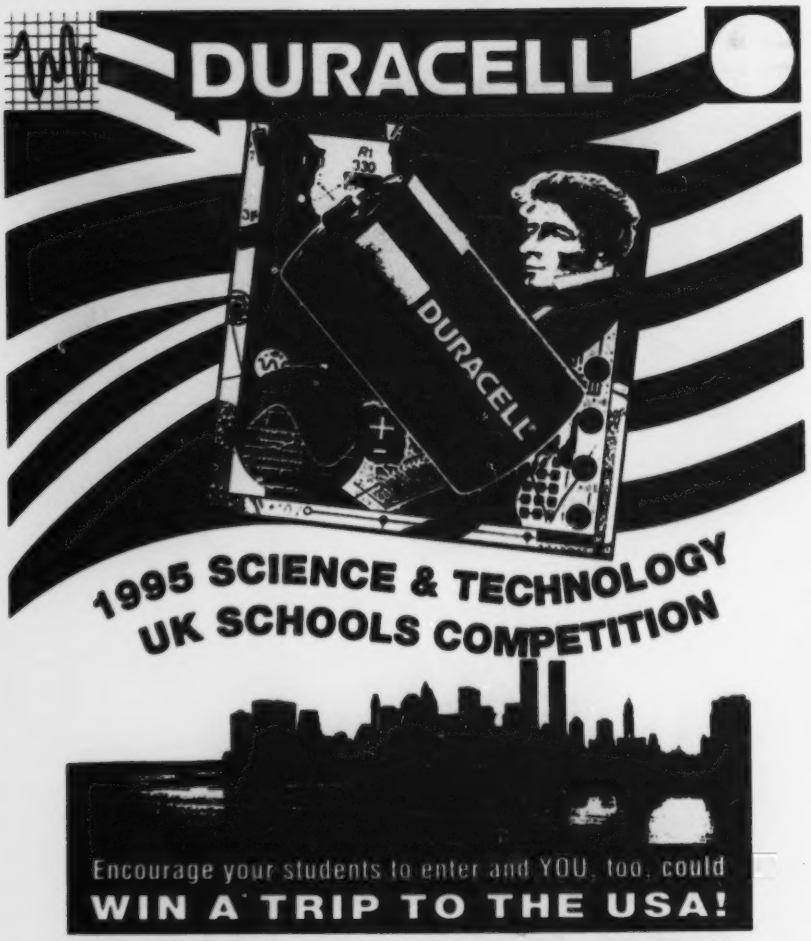
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what issues present-day schools and their managers are having to address.

Finally therefore, the message is that while collaboration between industry and education in the development of curriculum and curriculum materials is both right and necessary, what is equally valid is the pooling of knowledge and experience about ways of implementing change, whether this change is the introduction of new technology, or an appraisal system, or a new approach to delivering parts of the curriculum.

This deserves more focus both on the part of educationalists and on the part of businesses committed to working with schools and colleges, and I hope that you will give this some thought in your future collaborative ventures, and actions to take forward from the conference. If you wish to raise the position of design and technology teaching in schools you are seeking to manage a change, possibly even a culture change. Perhaps in terms of collaboration with industry therefore, the most useful question you can ask is 'How can we best manage that change and who can work with us to achieve this?'.

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Food technology at work

Roy Ballam

Kemnal Technology College

With the changes in Food Technology, Roy Ballam offered the DATA conference an insight into real food technology at work.

Many of the assignments mentioned in this article appear in his new pack *Food Technology at Work*, published by Technopacks, PO BOX 216, Epsom, Surrey KT19 9YH. He can be contacted on CompuServe 100332,1330.

From an early age I have been interested in food, especially when I was allowed the freedom to experiment and develop my own tasty treats. Now I teach in an all-boys college, showing students how to design using the medium of food. Every time I work with my students I get excited, filled with the hope that they too will enjoy the food experience.

So what is food technology?

People still seem not to know what it is, even though they teach it. Below is my interpretation of what food technology and home economics are. In no way am I devaluing Home Economics (being home economics trained myself), as there are many skills that need to be taught in order to design and progress through technology It is the approach to designing with food and making the changes (personal, resourcing or environmental) to facilitate the move to teach technology. It's not what you do, it's the way that you do it!

Food Technology	Home Economics
Industrial context	Image — what is it?
Open ended (can be closed task)	Intrinsic values/beliefs
Skills — generic	Context of home, family (food, clothing & shelter)
Management of resources	Who was it originally aimed at?
Creative ability	Set way to do something
Design driven	Approach — didactic
Changes in society/technology	
Ingredients properties/characteristics	

In order to explain my view of technology, I shall draw upon various assignments which I use at college with my students. Through these it is hoped that a true technological perspective can be illustrated in my working methods, and how rigorous food is as a design material.

Many people say that you can not design with food because you make it too quickly. Or that you can put chocolate chips in one cake and raisins in another — call that designing? In industry food has to be quickly processed, often in 24 hours, due to the nature of the food material.

Surely this is part of the design brief and specification. True, changing chocolate chips for raisins isn't much, but looking in depth at ingredient changes in food products leads to nutritional, physical and sensory changes. So why is food still being viewed poorly, especially as it has so much technological potential?

Assignments

Year 7 — Funny Face Pizza

This is a simple project for young food designers. The idea is that the pupils design and make a pizza with a funny face on top. All really enjoy the challenge, and all have the opportunity to develop an understanding of the ingredients they use. They also record what happens to the ingredients when cooked — with some amazing results! Pupils are always amazed that mushrooms shrink, cheese melts, bright green peppers go brown and bright yellow sweetcorn turns yellow-brown!

The approach

- A starting place for young food designers
- Working from a design brief and following a list of criteria (design specification)
- Looking at the nature and physical characteristics/properties of the foods
- Self-motivating and rewarding activities
- Using equipment
- Looking at the changes in ingredients
- Health and hygiene
- Cutting, chopping, using the oven

For nearly a year now, a local SEN school, Rectory Paddock, has on many occasions worked with my Year 7 classes. All pupils have the same brief, and all design and work together on practical sessions. This relationship has meant that both SEN and mainstream pupil work together and all perform a design assignment.

An excellent example of this was at Christmas when I set the design problem below. Both SEN and mainstream worked together to produce quality pies.

> **Design brief**
> Not everyone likes mince pies. Do you? What would you put in a Christmas pie? Using the food charts, design your own Christmas pie.

The pupils then used 'picture-word' cards of the foods they were allowed to use in their design (see figure 1). This was because of cost and keeping the pupils to a strict specification.

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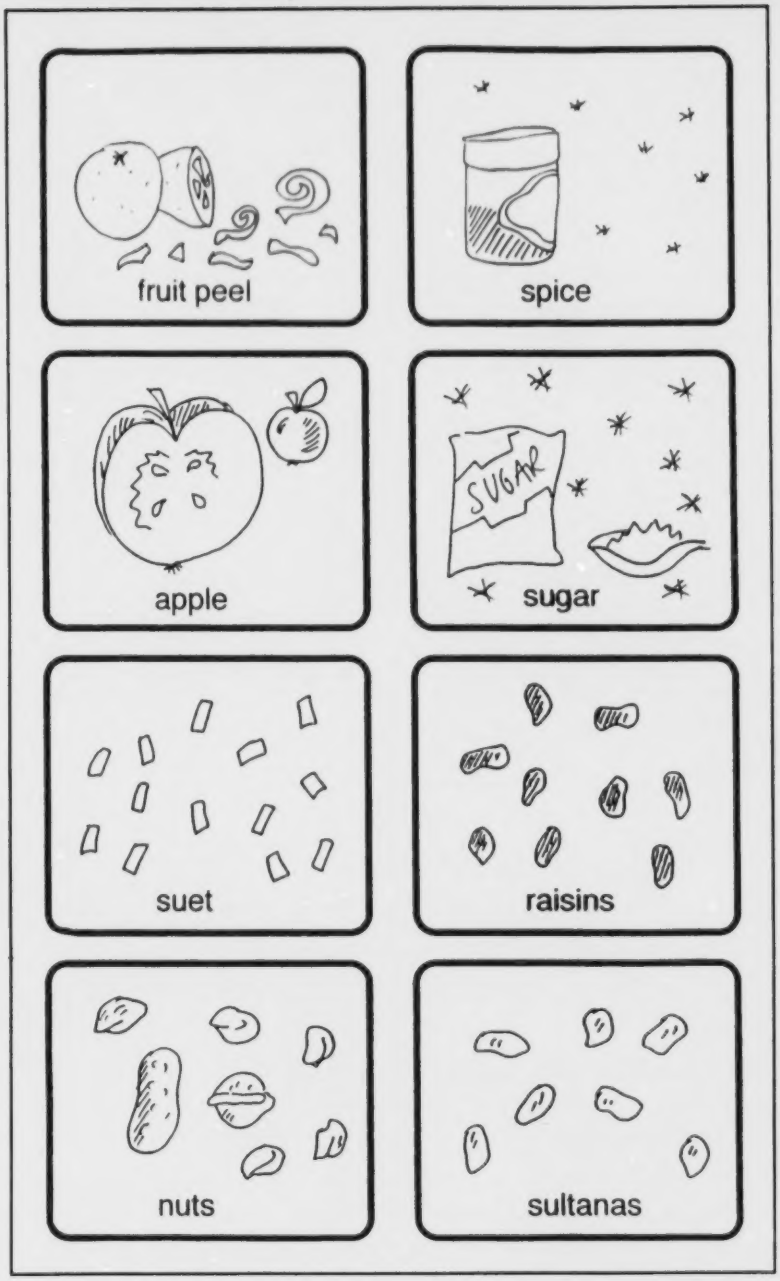

Figure 1: 'Picture-word' cards for good design

A large pie was then drawn on a piece of paper and the ingredients selected glued on top (see figure 2). All pupils enjoyed this working method, and followed their designs in the practical stage. It enabled the SEN pupils to design a product, by selecting ingredients they thought would be suitable.

Ways forward with SEN pupils

- Language development
- Making the task appropriate for a range of abilities (closed task)
- Building confidence using food
- Life skills
- Using pictures to aid design
- A sense of achievement at the end of a lesson

Year 8 — Mega Brilliant Chocolate Factory

When I started at Kemnal Technology College all pupils performed a project making a chocolate bar mould and packaging. However, the project then stopped. Now we take it one step further and design the filling and test the mould. The starting place is looking at other chocolate bar products to see how they are made and using this information as a basis for design work. This gives pupils a clear indication of what can be achieved, how they are made and the types of ingredients used.

Experimentation is an important part in this project, as pupils have the chance to make their bars at least three times. This is important as too often pupils make their product once, giving no time for reflection and real change from their evaluations. One pupil. Jake. wanted to produce green chocolate. He experimented by adding food colouring but discovered that the colour prevented the chocolate from setting. Only through experimentation did Jake succeed in his quest. Another area which is developed is ingredient analysis. All pupils must justify the ingredients used. then analyse their use in the manufacture of their product (see figure 3).

The approach

- Product and applications (looking at how other bars are constructed)
- Making links with other parts of Technology: graphics. card construction. wood, plastic, clay
- Simple to set up and manage
- Gain pupils' interest and motivation
- Gives an understanding that Food Technology is involved — it is not just baking!
- Working towards a design brief/specification
- Develops pupils' creative and aesthetic awareness
- Food properties

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Figure 2: The 'ingredients' are then pasted on the pie

Other year 8 protects in brief

Cheese project

Links with plastics ingredient analysis and sensory analysis. This project started when I took 30 boys to France on a cuisine trip. One day we visited a small cheese farm, where an elderly lady showed us how she made the cheese. She held up a huge plastic mould to pour the cheese mixture in and my brain started thinking of how pupils could do this in school, using acrylic strips and designing and making their own cheese — excellent for sensory work cross media scientific principles — boys are amazed how two liquids (milk and rennet) can make a solid!

Pop tarts

Disassemble products, taking a product which is known to this youth culture and exploiting its properties. Look at alternative designs. how they fit together, different cultures — pop tarts around the world, 3-course pop tart, the brunch pop tart!

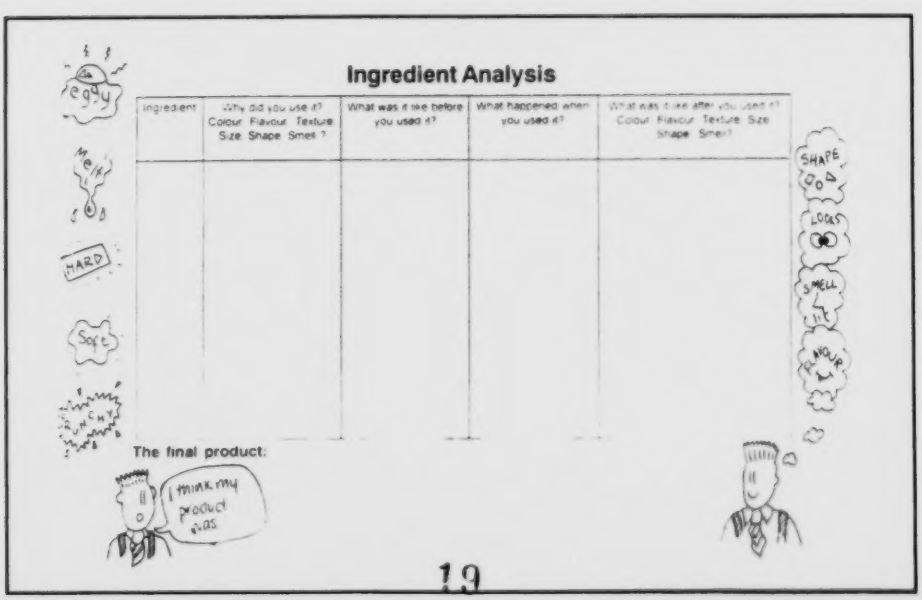
Year 9 — Sensory Analysis and Product Development

During this year much work is completed with sensory analysis. It is intrinsic to food, as it is the only material that you can safely eat. It is a skill that needs to be taught and pupils need to learn different methodologies to evaluate and modify products which they will be producing.

I remember boys sticking spoons in saucepans saying 'Yeah — thats nice!' or 'That's pukka, mate!' Through this I decided that this skill needed to be taught. During a visit to the Meat and Livestock Commission I saw how much importance industry paid to it so I developed a short course at college. The approach was to make it a posh affair, have a tasting box with lime cordial, plates, napkins, cups and cocktail sticks. The pupils saw how seriously I took it and now take their time in the tasting sessions

Another area of development is enabling pupils to understand and work towards a product specification. This I have found aids the design process and gives pupils clear targets and useful reference criteria during evaluations. A

Figure 3: Chart used for ingredient analysis


Ingredient Analysis
Ingredient
Why did you use it? Colour Flavour Texture Size Shape Smell ?
What was it like before you used it?
What happened when you used it?
What was it like after you used it? Colour Flavour Texture Size Shape Smell
The final product:
I think my product was...
SHAPE
LOOKS
SMELL
FLAVOUR
HARD
SOFT

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simple assignment was 'Cake Designer', where a strict specification was set, using ingredient and economic limitations.

The main idea is that pupils can see the inter-relationship of money in the design and manufacture of a product. Pupils keep a production planner of their design. and record all stages of making (including the time spent!). They are then asked whether any economic savings could be made in the manufacture of their product. Analysis of ingredient use and making is then undertaken.

Quality

To understand the notion of 'quality' pupils evaluate a range of sausages. These range from *economy, skinless, low fat, normal*(!), *vegetarian, black sausage* and *luxury.* All are cooked in the same way. The class then analyse each sausage being cooked through stages of preparation, cooking and tasting. This is achieved by questioning the pupils, and completing a food evaluation chart. Through this pupils build up a bank of knowledge about what makes a good quality sausage, but more importantly the understanding of how to evaluate the quality of other products (including their own). In time they build a library of criteria of what makes a quality product.

Learning outcomes

- Business and Industrial understanding of the food industry
- Sensory analysis skills
- Team work/building
- Producing a product to a strict specification
- Quality control
- Batch production
- Portion Control

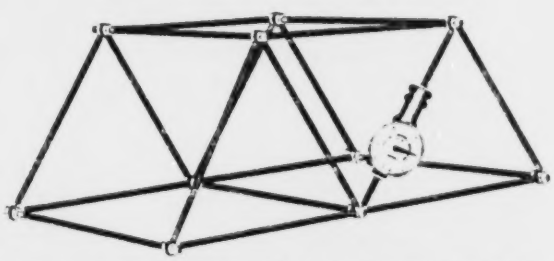
And lastly . . .

At college I teach only food technology; I'm not interested in making pretty cardboard boxes for the food I produce in my lesson time. I talk to many people who spend enormous amounts of time on packaging. I'm here to show students how to design with food and exploit their working characteristics, not spend six weeks making a piece of packaging!

Just because food surrounds us, it doesn't mean that we all understand it. It needs to be taught by specialists, just as construction and graphics. Food technology isn't cooking — exploiting the characteristics of ingredients is.

Food is fun, but also a serious design medium with technological potential! We should celebrate the use of food in schools, as it enriches our lives and brings us all much pleasure!

Build on our experience



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The NAAIDT Response to the Proposed Curriculum

The National Association of Advisers and Inspectors in Design and Technology (NAAIDT) has taken an active part in consultations on revisions to the statutory Order during recent years. On receipt of the May 1994 proposals its executive committee met and subsequently corresponded with all members to raise the major issues for debate during the next stage of consultation.

To contact NAAIDT, send SAE to: The Hon Sec. NAAIDT, 124 Kidmore Road, Caversham, Reading, Berks. RG4 7NB

At the time of writing the NAAIDT response to the latest proposals has not been finalised but discussions have begun to highlight some of the strengths and weaknesses. Broadly it is felt that things are moving in the right direction but there are still some fundamental issues to clarify and, in some areas, detailed work to be undertaken.

NAAIDT has an established policy statement on design and technology and revisions to the Order are considered in the light of the curriculum position set out in this policy as well as making reference to the aim of the review as outlined on page i of the proposals.

Attainment Targets — the two AT structure was proposed by NAAIDT at the time of the first revision and we have been consistent in our support for it. The structure clearly identifies Designing and Making as the central features of D&T. The Association, however, would wish to emphasise that there are aspects of designing such as research, investigation, exploration and evaluation which must not be overlooked. The removal of ATs 1 and 4 must not be interpreted as the demise of these essential aspects of D&T activity. To this end the Association is pleased to note the inclusion of planning and evaluation within the designing and making sections of the proposed PoS. We particularly welcome the fact that, through the format and, in most cases through the content, the planning and evaluation material relates to both designing and making. It is felt, however, that there is more work to be done on the evaluation section of the PoS, particularly at KS4 where the evaluation of products is emphasised with little mention of the design process. Also the concept of planning at KS1 is unclear and not a good basis for progression. It would be helpful to introduce statements such as: 'describe what they are going to do. '

Level Descriptions — The aim of simplifying summative assessment is wholeheartedly supported by the Association. We believe that the concept of a 'best-fit' approach to assessment through the level descriptions will make summary judgements more manageable. Whilst agreeing with the concept we feel, however, that more work needs to be done on the wording of the descriptions to ensure that they adequately define the key elements that characterise each level and support teachers in recognising potential differences between pupils. It is also recognised that, in this new approach to summative assessment, there is a heavy reliance on professional judgement and there will be a need for training and moderation. It is helpful that the proposals identify clearly that the role of the level descriptions is to support summary judgements. A particular concern to many NAAIDT members currently is the varied practice in relation to formative assessment, as identified through the OFSTED inspection process. It is with interest therefore that we note the suggested new approach to day-to-day assessment of pupils' work ie. using the programmes of study. We believe that this is an area where teachers will need considerable support and guidance.

Programmes of study — the Association supports the direct link between the KS PoS and the ATs, as shown through the introduction of the sections on 'designing skills' and 'making skills'. The introduction of a section entitled 'knowledge and understanding' is also welcomed as it reduces the ambiguity about what should be taught and recognises the need for pupils to apply knowledge to their designing and making activities in order to establish relevance and rigour.

The Association is pleased to see a section in the PoS which describes the 'range of activities' but there is some concern about the lack of reference to the inter-relationship between the three classifications of activity. Whilst it is recognised that there are times when these activities take place independently from each other, it is felt that there are dangers in pupils engaging too often in 'focused practical tasks' or 'activities in which pupils investigate, disassemble and evaluate products', in isolation from and without reference to their designing and making assignments. It is felt that care is needed to ensure that the balance is right to ensure the development of design and technology capability. Similarly the knowledge and understanding as defined in the PoS must be taught through the range of activities.

Having identified a level of satisfaction with the main headings in the PoS, there are, however, some concerns about the level of detail within some sections of the PoS and the discrepancies between Key Stages, for example, under 'knowledge and understanding' the 'materials' section is much more detailed for KS3 than for KS1 and 2. It is felt that there are some areas of the PoS where further detail

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and specificity are required within the legal framework ie. what must be taught. There are other aspects which need exemplars and guidance which will be best provided through non-statutory guidance. The Association supports the provision of non-statutory guidance and is in a position to help in the preparation of such material. It is felt that the guidance should be published at the same time as the new Order.

Designing and Making Assignments — the Association has agreed with the concept of design and make tasks/assignments since the idea was introduced in the 1992 revision. Generally it is felt that the minimum number, recommended for each KS within the current proposals, is appropriate although some guidance on the curriculum planning issues will be needed. An area for further discussion is the nature and level of specification for the design and make assignments at each KS. The requirements for the assignments raise issues about materials beyond those highlighted by the optional food at KS3 issue, for example, are textile materials also optional, what about construction materials — are these sufficiently specified? Do we all share the same definition of compliant materials? Is the inclusion of a choice of control systems at KS3 appropriate?

The Association regrets the emphasis placed in the response form to the issue of food at KS3 when there are other issues that equally merit full debate such as those relating to other materials and the nature of content. The Association believes that pupils should use materials as appropriate to the design situation applying the relevant knowledge and skills. If food is optional, matters of breadth and progression are raised. If it is compulsory the matter of time must be considered as it is assumed that the 63 hours is based on delivering the compulsory material as set out in the proposals.

Key Stage 4 — the defining of a set of core requirements at KS4 is important. It is felt that it is essential to use this core as a basis for all courses and, to balance the idea of introducing flexibility at this stage with the need to clearly define the nature of the subject and retain its integrity. There are concerns about whether the core as defined can be delivered in 5% of curriculum time and about accreditation and 'currency' of short courses. The Association has always advocated at least 10% of curriculum time at KS4. The exercise of designing a short course and then extending can lead to a lack of coherence, although the flexibility of working predominantly in one material overcomes this, to some extent. The question still remains as to whether the content of the core in the proposals is appropriate and whether it can be largely delivered through single materials. To be judged fully, the KS4 proposals must be seen alongside the GCSE criteria, and these are not available at the time of writing.

Information Technology — the Association has consistently supported a structure that separates IT and D&T and therefore welcomes the proposal to present D&T and IT discretely and, to remove any links in relation to assessment and reporting. To emphasise the separation in relation to structure it would be helpful if the two could be presented using different colours for folders, etc. The Association is strongly in favour of the references to IT in D&T within each KS PoS and believes that there is a need to further develop the content to ensure that elements of IT which support designing and making, for example, control, modelling and graphics, are made explicit. The Association has recently produced a guideline on IT within D&T which will support planning in this area.

Format — the format is acceptable in setting out the statutory requirements for the subject but it is not a helpful format for the teacher who is working at a KS and trying to get an overview of what needs to be covered, nor is it helpful for whole school or cross KS planning. Presentation in a variety of forms would be helpful and avoid hundreds of teachers 'cutting and pasting'. At the primary phase the appropriateness of a common format across subjects should be taken into account.

Definition — it is helpful to clarify the nature of D&T. The proposed definition 'Design and technology capability requires pupils to combine their designing and making skills with knowledge and understanding in order to design and make products', regrettably does not include the concepts of creativity and quality, nor is reference made to testing and evaluation . NAAIDT in previous responses has suggested a definition: 'Design and Technology capability requires pupils to combine their designing and making skills with knowledge and understanding in order to design and make products of quality which can be evaluated and tested in use'.

NAAIDT recognises how essential it is to 'get it right' this time and we await with a keen interest the outcomes of the consultation. Members of the Association will through inspection, advice, courses and publications be supporting schools in planning for implementation in September 1995.

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Thursday 15th December 1994

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Muscling in: using Shadow Muscles for Modelling

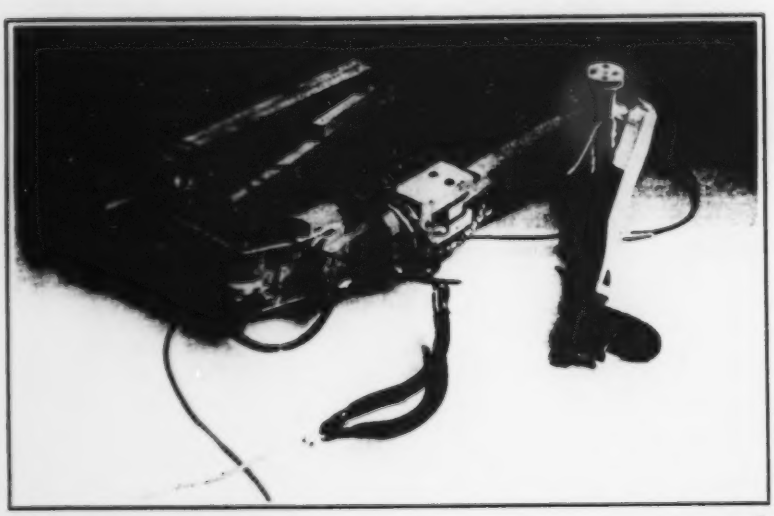
John Hanson

Educational Technology Consultant, W. Yorkshire

I was recently bemoaning the inadequacies of pneumatic equipment for technology when a friend drew my attention to a new development by Shadow Project, called Shadow Muscles. Intrigued by what I heard, I contacted them and was lent a set to try out.

A Shadow Muscle looks like a long thin rubber bag in a tube of black plastic mesh similar to the nets which oranges are packed in. They come in different sizes, most being about 10cm long and 2cm wide; the longest is about 30cm long and 2cm wide. Metal clips which can be squeezed on to close each end form loops in the plastic mesh for fixing, and an air tube emerges from one end. When you allow pressurised air into the tube, the rubber bag expands and the mesh, also expanded, shortens its length and produces a pull on both ends. The plastic mesh restrains the rubber bag so that it can expand fairly uniformly down its length. They work (and look) like a human biceps muscle bending an arm and this analogy produced the most rewarding model I made with them.

Shadow Muscle is a brilliantly simple concept and much of the cleverness of this system lies in the software, interface and air control. On a sturdy base plate is the computer interface and four air control valves which require an external supply of pressurised air. The air pipes are easy to fit and helpful diagrams show you how to connect them. You can work them directly by inflating one muscle from each valve, or use two valves for each muscle, which allows you to inflate the muscle, hold it inflated and actively empty it, all with precise control.



The interface is well built but unboxed. I like to see the electronics showing: this helps to remove the black box mystique, but some people may find it intimidating, and others may be tempted to tamper with it. The interface connects with the serial port on the computer and has an expansion port which enables the connection of additional interfaces and air valves, and sockets for the connection of sensors. The sensors are also sturdy with well made, easily obtainable components such as switches which could easily be adapted to the user's requirements. The software, which I used with an Acorn Archimedes, is very visual, easy to use and very forgiving. I found the direct control facility invaluable for testing the operation of mechanisms I had built, before I began to program them.

I had several days of entertainment from using the system. Fairly experienced in the use of interfaces and control mechanisms, I was pleasantly surprised by the ease with which I could build and use models with this system. The first model I tried was a Lego version of a life-sized animated head, which was originally built as an illustration for the NCET IT in D&T GEST material. The large original had taken a colleague several days to build from wood and was driven by large, conventional pneumatic valves controlled by a separate interface. My Lego and Shadow Muscle version was roughly half life size and although not as smoothly operating as the original, performed almost all the same functions: the head turned, the tongue went in and out and the eyes and ears moved. My model took about two hours to build, and I spent less than half an hour producing a workable program.

Using the muscles rather than the usual pneumatic brute force pistons made me think much more carefully about the angles and positions used in the construction. The muscles and the elastic bands used as antagonists to the muscles exert a tremendous static force on the model, and several times joints collapsed under these forces. At one point I managed to get the muscles to work in reverse because I had put them under insufficient tension, and on several occasions a small change of angle produced very large improvements. By the time I had finished construction, I had relearned several valuable lessons on forces and elasticity.

The best model I built was a simple one of an arm, with a 30cm long Shadow Muscle as the biceps and an elastic band as the triceps. I

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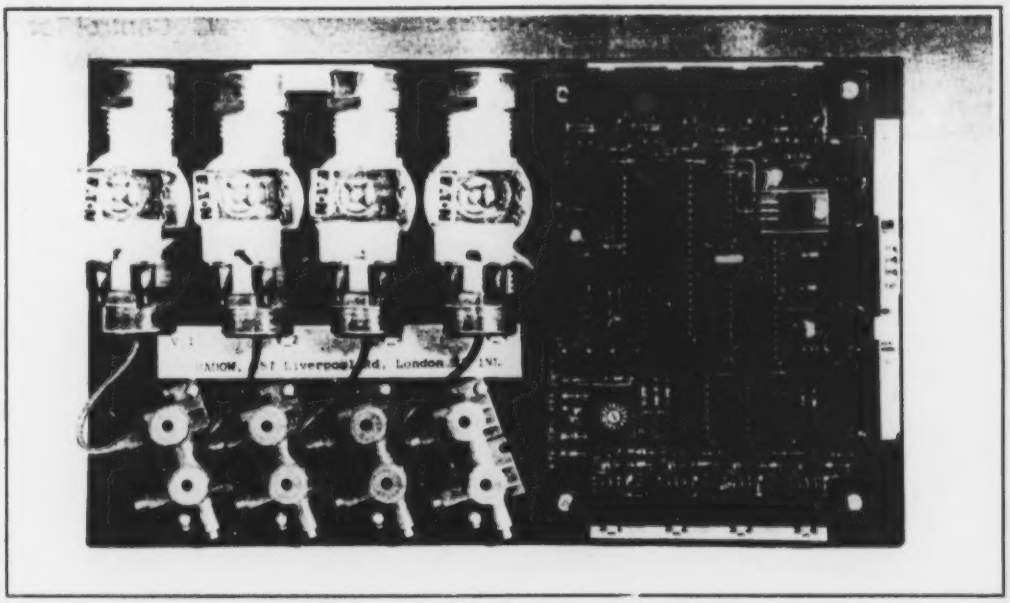
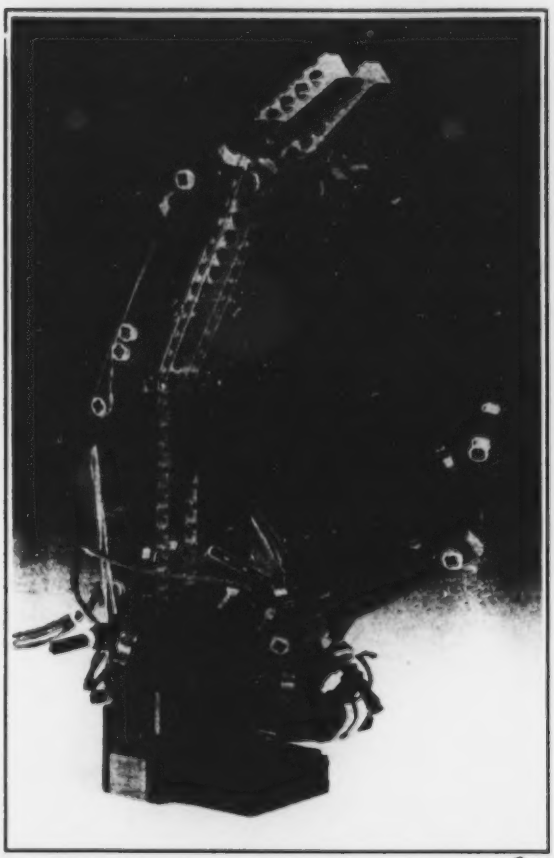


spent several hours experimenting with this simple and easily constructed model and eventually, by adjusting the air valves and the timings of the program, produced a very smooth-running simulation of the arm lifting a pair of scissors.



The air can be supplied by a normal compressor and the valves allow for a wide range of adjustment of pressure, but I worked the system at home using a small air canister and connection for an air brush, and had few problems. The ease of use and flexibility of air supply could put this interesting area of pneumatics within the reach of primary schools without compressors.

This is a very interesting and exciting development in control technology and will strongly contribute to the use of pneumatics. I can see some very useful teaching points in the area of forces, angles and elasticity. The concept is a radical jump away from conventional pneumatics and makes a difficult area much easier to understand. It does not relate in any way to the industrial use of pneumatics but is very appropriate to the mechanisms used at school level. Well supported by an excellent manual, good software and sturdy equipment, Shadow Muscle gives the impression of careful thought and quality. A little more development in its use in a range of educational situations (and adaptation to other computer platforms and interfaces), and it provides a creative, pleasing and long needed innovation.

Shadow Muscle is available from Shadow Project, 357 Liverpool Road, London N1 1NL. Tel: 071-700 2487. The Shadow Kit costs £299 and includes control board, software, 11 muscles, sensors, switches, air pipes and 12v power supply.

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New Light on Pneumatics

Richard Sykes

Technical Writer,
Economatics (Education) Ltd

With pneumatics playing an increasingly important role in industry, and the design and technology curriculum in process of revision, now is a good time to re-examine the place of pneumatics in design and technology.

Pneumatics has been rather a shadowy presence in the design and technology curriculum documents published over the last four years, its inclusion or lack of it being something of an indicator of each document's commitment to control technology. The original order makes only a passing reference to pupils knowing that mechanisms can be incorporated within pneumatic systems, whereas the proposals published in December 1992 (the fold-out) at the height of the Blue Peter technology debate go so far as to specify that pupils be taught the use of a detailed list of pneumatic components.

So what really is the place of pneumatics in design and technology? This article sets out to explore this issue by looking at three interlinked areas: the place of pneumatics in control technology in the world outside school, the current use of pneumatics in schools in KS3 and KS4, and, to begin with, the part it has played in the development of the subject of design and technology.

Small-scale industrial pneumatics integrate easily with construction kits like Fischertechnik for prototyping project ideas; they operate at safe low pressures, suitable for the classroom

Control Technology

A significant factor in the development from craft subjects into CDT was the Schools Council Project Technology scheme which was published in the Control Technology books in 1974. It is interesting now to see how this first attempt to frame a whole field of scientific and engineering activity into a school subject, dealt with pneumatics. Alongside sections on structures and electronics was a central section on the control of movement: electrical switching to control the source of rotary movement — an electric motor, and valves to control the source of linear movement — a pneumatic cylinder. Both were presented as being of equal importance.

The growth of control technology led to a second Schools Council project, Modular Courses in Technology, in the early eighties. This created the model of GCSE technology as a general core with a choice of specialist modules. In this rather fragmented approach, pupils experienced pneumatics only if it was one of the modules chosen by their school. It is worth comparing this model with a parallel development, the Scottish Standard Grade Technological Studies syllabus, which has pneumatics as one of its core subjects; the others being mechanisms, electronics and technology in manufacture with the emphasis on integration of all four.

Another interesting comparison is that between the uncertain place of pneumatics in the orders for England and Wales, and the more positive view taken in the equivalent order for Northern Ireland in which pupils both at KS3 and KS4 are to be taught to use pneumatic cylinders and valves in circuits to achieve desired effects. It would appear that curriculum developers in Scotland and Northern Ireland have a vision of technology that embraces more of the nature of control technology as it exists outside schools.

The World Outside School

In the world of control technology outside school, the design engineer has a choice of three basic types of actuator — electrical, pneumatic and hydraulic — to provide force and movement. Each has its strengths and weaknesses and each is appropriate for particular purposes. It is likely that all three would be accompanied by an electronic control system that is either hard wired or programmable.

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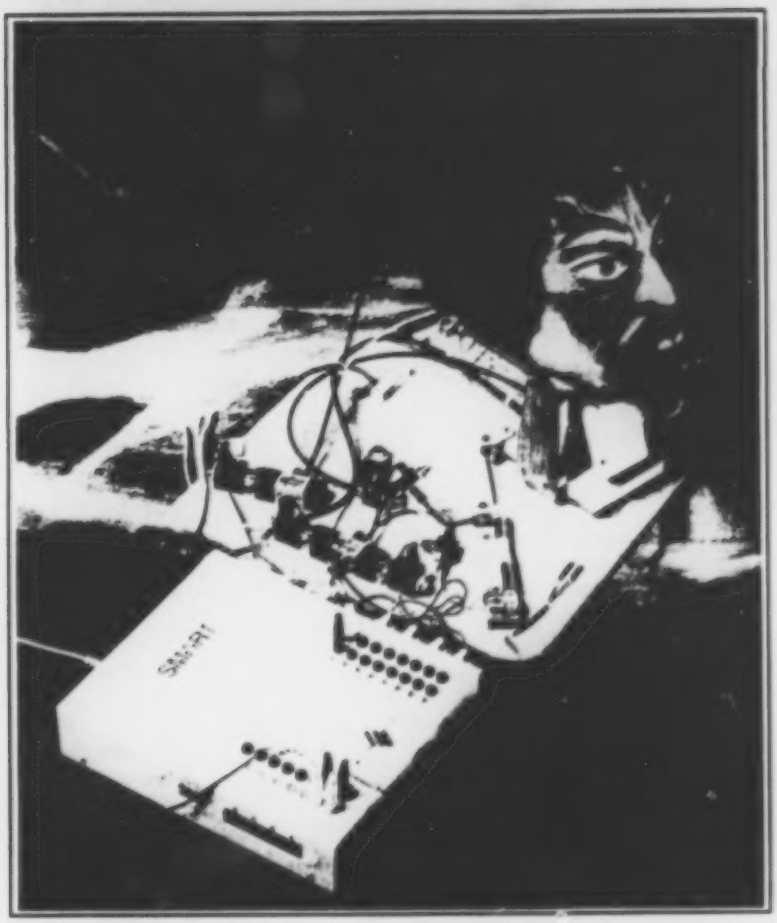

This animated head, made as part of an NCET project in control technology, shows how pneumatics can be integrated with computer control in a design and make project

Over the last ten years, major advances in pneumatics technology have meant that it is increasingly favoured over electrical and hydraulic systems. New designs of valves and cylinders have brought greater efficiency; electronic control has increased accuracy and speed of response; and miniaturisation has meant that a pneumatic system now occupies a quarter of the space it would have needed ten years ago.

The majority of automated manufacturing processes, especially in industries such as plastics, furniture, food and clothing make extensive use of pneumatics because it is clean, safe, lightweight and cost-effective. A pneumatic system compares favourably with electrical and hydraulic equivalents when it comes to maintenance, durability and cost of manufacture. The automotive industry is making increasing use of pneumatics, not only in manufacturing processes, but in on-board systems such as suspension and central locking. The new clutchless car makes use of a pneumatic gear selection system. In the fast developing world of theme park thrill rides, pneumatic systems are used to fix safety harnesses in place and to fire the passenger vehicle at high speed into the looping ride.

The growth of the pneumatics industry is indicated by the fact that in excess of £80m are now spent annually on pneumatic components in the UK, compared with some £50m ten years ago. In the same period, the hydraulics industry has suffered something like a twenty-five per cent reduction.

■ Classroom Experience

Talking to teachers about their reasons for including pneumatics in their design and technology work, three ideas emerge:

i) It has to be included if pupils are to be given a complete and balanced experience of control technology as it exists in the world outside school.

ii) It opens up the range of possible design and make projects for pupils, and generates new project ideas.

iii) It makes an ideal vehicle for teaching ideas about systems and control.

In the words of one teacher: 'For me, systems and control work should be built around pneumatics because of its immediacy and simplicity, and the way it motivates pupils. In half an hour they can learn something, use it and get a real sense of achievement'. This is true across the full ability range. For the teacher, trouble-shooting is much simpler than with, say, electronics. There are fewer possibilities for error, you can see what is happening, and altering a circuit is simply a matter of reconnecting pipes to push fittings, rather than desoldering components.

■ School-Industry Links

One of the purposes of school-industry links is to give pupils awareness and understanding of industry. Where this involves factory visits teachers find that, for pupils who are familiar with pneumatics, the array of modern machinery is far less intimidating and often serves to stimulate project ideas such as pneumatically-operated pick and place devices or systems for moving material on and off conveyors. Pneumatics is particularly useful in projects that involve pupils' own small scale manufacture. Chip making and can crushing for recycling are popular projects; more enterprising ones include printing tickets for

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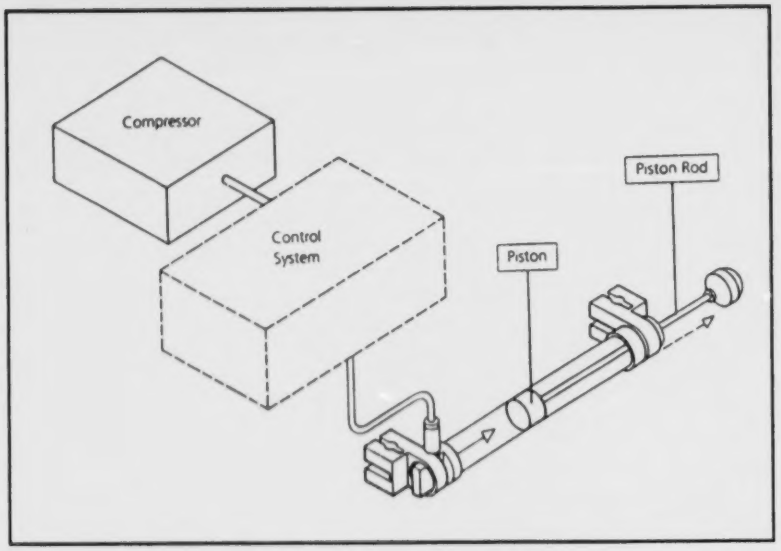

Fig. 1:
When compressed air is released into a cylinder, the piston rod moves, providing linear force and movement

local events and manufacturing plastic belts using pneumatics to stamp holes and insert rivets for buckles.

The use of pneumatics in the areas of leisure and animation is also reflected in school projects. One pupil's advertisement for a tyre company featured an animated arm pumping up an inflating tyre. At another school, a group of pupils have produced an animated version of the *Three Little Pigs* complete with pneumatically-operated collapsing house and a wolf who huffs and puffs by means of a pneumatic cylinder.

■ KS3 Systems and Control

Projects such as these tend to be done in KS4, but pneumatics is also used extensively in KS3 and is highly relevant to the latest draft proposals for design and technology in that it makes tangible many of the key elements of systems and control specified at this level; i.e. pupils should be taught to use devices that control and transmit energy; to interconnect mechanisms to achieve different kinds of movement; to know that systems have inputs, processes and outputs; and to incorporate feedback in their systems.

The idea of a compressor as a device that uses a pump to compress air into a reservoir is easily explained to any pupil who has ever pumped up a bicycle tyre. The pneumatic cylinder is an eminently simple device for transmitting energy (see Figure 1). Pressing the button on a control valve and seeing a piston rod move as a result provides a clear practical demonstration of the concept of input and output. Once this is understood, the introduction of another valve as a second input clarifies the idea of AND and OR logic functions. Adding a flow restrictor to control the speed of the piston rod, or a reservoir to give a time delay provides further examples of process. Alternatively, the input of a system could be the linear movement provided by a cylinder, the process a series of linkages or other mechanisms, and the output a movement or number of movements on, for example, an animated face.

In pneumatic systems, the need for feedback in the form of proof of position is easily understood. In the system shown in Figure 2, cylinder A pushes a container under a hopper and cylinder B tips the hopper so that its contents pour into the container. It is clearly important that a feedback loop is built into the system so that cylinder B will not tip until there is proof that cylinder A has pushed the container into position. Proof of position can be achieved using just pneumatic components, but this kind of control of cylinders in conjunction with sensors provides a natural progression into integrating pneumatics with electronic or computer control systems, which is what schools tend to do in KS4.

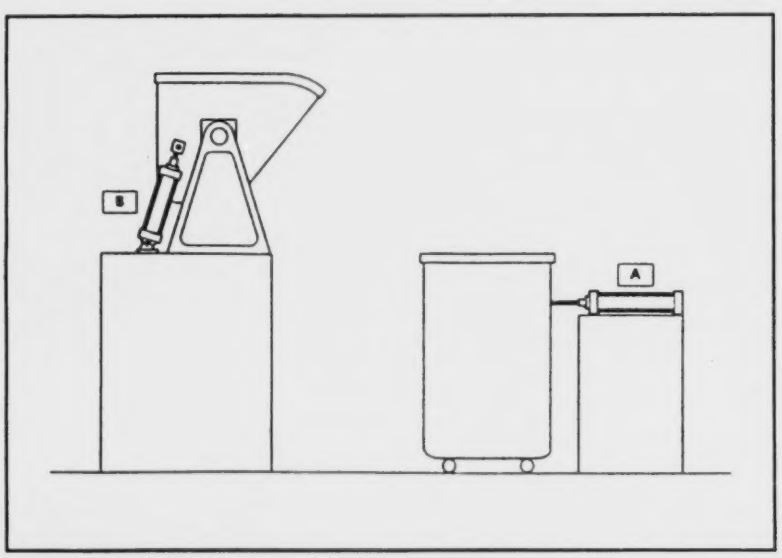

Fig. 2: The need for proof of position feedback

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Equipping for Pneumatics

Equipping to teach pneumatics need not be either costly or complicated. A pneumatics workstation comprises a number of basic components, a firm base to fix them to, and a source of compressed air. As a beginning, this could be a small mobile compressor which would supply one or two workstations used for teacher demonstrating and practical work by groups of pupils as part of a circus of systems and control activities. Schools equipping for pneumatics with whole classes would look to provide five to ten workstations supplied by a large fixed compressor with an airline installed around the workshop, preferably inside service trunking alongside the low voltage electricity supply. This obviously represents a substantial investment but has the advantage that, once set up, the resource lasts for years with no additional cost other than the occasional coil of pipe.

Whatever the future of pneumatics in design and technology curriculum orders and syllabuses, two points are clear. The increasing number of teachers who use pneumatics find it to be an excellent way to teach systems and control, and any coverage of modern control technology without it is simply incomplete.

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Mouse Manoeuvres: the IEE World Micromouse Championships 1994

Steve Woolley

Head of Technology, Bancroft's School, Woodford Green, Essex

Each year the Institution of Electrical Engineers organises this competition and it attracts entries from around the world. The competition involves building and training a 'mouse' to negotiate a maze, learn the best route to the centre, and then make the fastest possible run from the start to the centre. The 'mouse' is a steerable motorised buggy with sensors fitted to enable it to detect the maze walls and to respond accordingly.

The competition has been the almost exclusive preserve of teams from industry and university departments, but last year a new teenage category was introduced, opening the competition up to school-based teams. In the senior categories the 'mice' are autonomous, microprocessor-controlled buggies of a high degree of sophistication, but the proposed teenage category rules allow for control by wire, either linked to manual control boxes or to microcomputers. This is an exciting challenge to school-based technologists which involves design, making, electronic, and IT skills.

Entry details and a full set of rules are available from the IEE (address below) and they also produce a technical information pack to help prospective mice manufacturers, but here are some basic details.

The maze consists of a 16 x 16 matrix of cells with removable walls that enable the complexity of the maze to be varied for the different categories of entry. The walls are 5 cm high, 1.2 cm thick and spaced 16.8 cm apart. The mouse must be able to negotiate the passages between the walls but may have sensors which overhang the walls provided the overall dimensions of the mouse do not exceed 25 cm x 25 cm. Figure 1 shows details of the maze construction and figure 2 gives an example of a maze layout. It will not be practicable, in most schools, to attempt to build a full-size maze to the specifications laid down in the rules — it measures over 3 metres square and is rather heavy! It is, however, worth while making a small maze section to experiment with. The photographs show the section my teams are using, which was made using MDF and simple dowel joints, not bothering with slotted posts at every wall intersection as used in the 'real' maze.

The mouse can be made in a wide variety of ways with a range of different materials, but for first ventures into mouse country I would recommend the use of construction kits. We were fortunate to enlist the support of Economatics (Education) Ltd who kindly provided a selection of Fischertechnik materials together with a Smart Box interface and Smart Move software. Fischertechnik construction kits enable pupils to experiment with different mouse designs and to produce robust prototypes for testing other aspects of the problem.

One particularly useful starting point is the Fischertechnik 'Kickstart' Buggy. This enables a two drive wheel buggy to be easily assembled and incorporates rotation counters on both drive wheels, which are essential for controlling distance travelled and monitoring the current position of the mouse in the maze. The basic buggy is not suitable for use as it is too large to negotiate the maze but can be modified quite easily to suit the purpose.

Once a mouse of some description has been built, some experimentation and tuning will be necessary to test its basic functions: it must be capable of travelling in a straight line and turn through 90° in the maze reliably! A simple manual control box for testing out basic mouse movements can be made cheaply and easily using two centre-off double-pole change-over

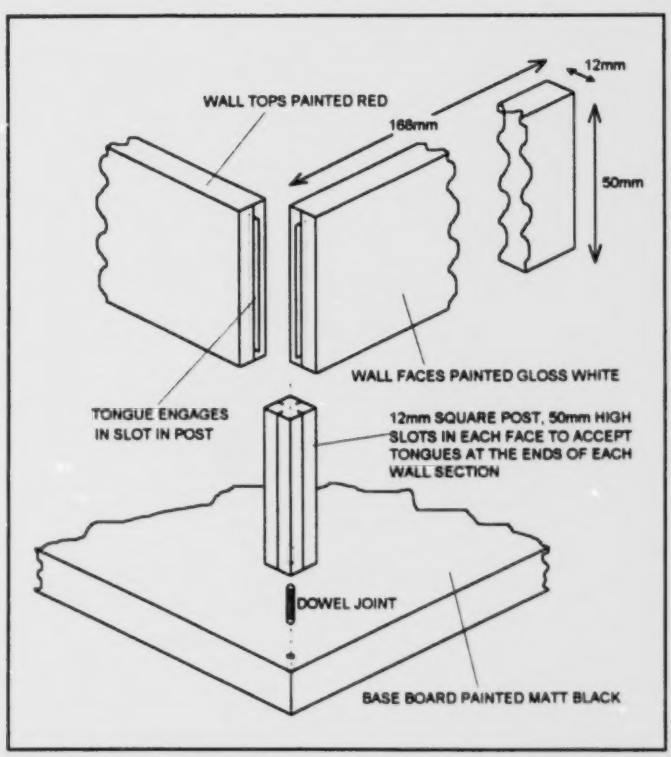
12mm
WALL TOPS PAINTED RED
168mm
50mm
WALL FACES PAINTED GLOSS WHITE
TONGUE ENGAGES IN SLOT IN POST
12mm SQUARE POST, 50mm HIGH SLOTS IN EACH FACE TO ACCEPT TONGUES AT THE ENDS OF EACH WALL SECTION
DOWEL JOINT
BASE BOARD PAINTED MATT BLACK

Figure 1: Basic maze construction

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Figure 2: Based on a maze used in the 1981 London Final

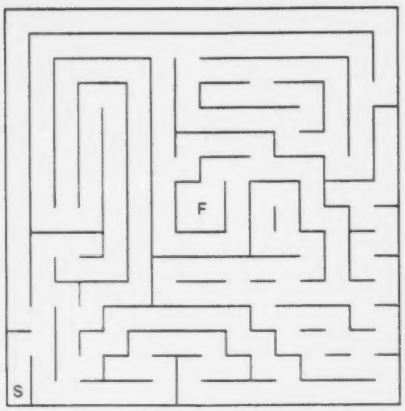
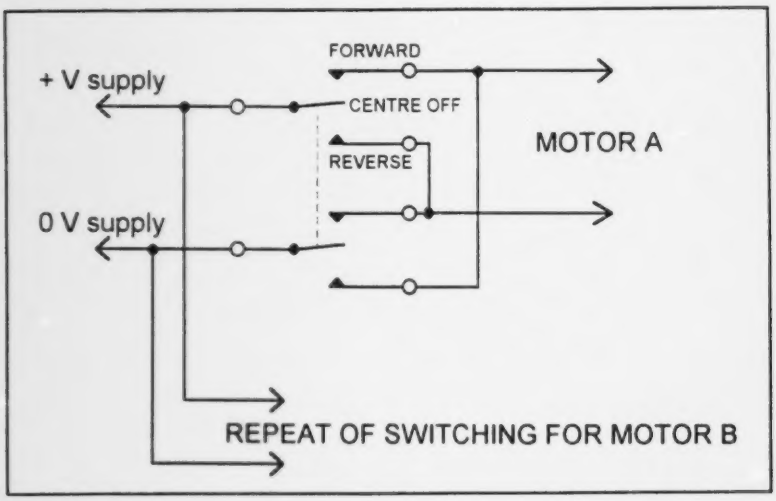


Figure 3



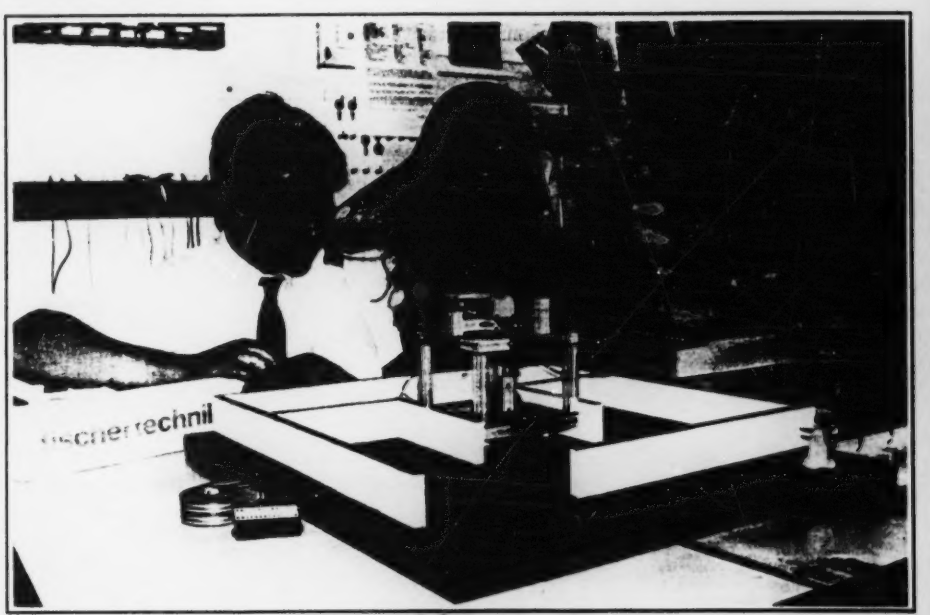
switches as reversing switches (see figure 3). Manual control could be refined by building simple electronic systems into the control box to effect right and left 90° turns and to respond to feedback from simple sensors.

To explore the potential of the Smart Box and Smart Move software the modified Kickstart Buggy was fitted with LDR (light-dependent resistor) sensors to detect side walls and obstructions in front. The LDRs respond to variations in light reflected from the red wall tops and when connected to Smart User Adaptors give a digital signal in the range 0-255 according to level. (The Smart Box has input ports for up to four analogue sensors of this type.) The two rotation counters were connected to two of the eight digital input terminals, and the motors to the motor outputs.

The Smart Move software is Logo-like and simple procedures can be written to control the mouse with ease. The documentation accompanying the Kickstart Buggy provides useful help in tackling basic maze manoeuvres. Once the basic principles have been mastered it is possible to develop more elaborate control procedures. We have attempted to break the programming process into stages, progressing from simple tasks to more involved problems.

The first stage is simply getting the mouse to perform the basic manoeuvres required to negotiate the maze: running in a straight line, 90° turns and 180° turns. The second stage is getting the mouse to respond to sensor inputs

Testing the steering system of the prototype mouse



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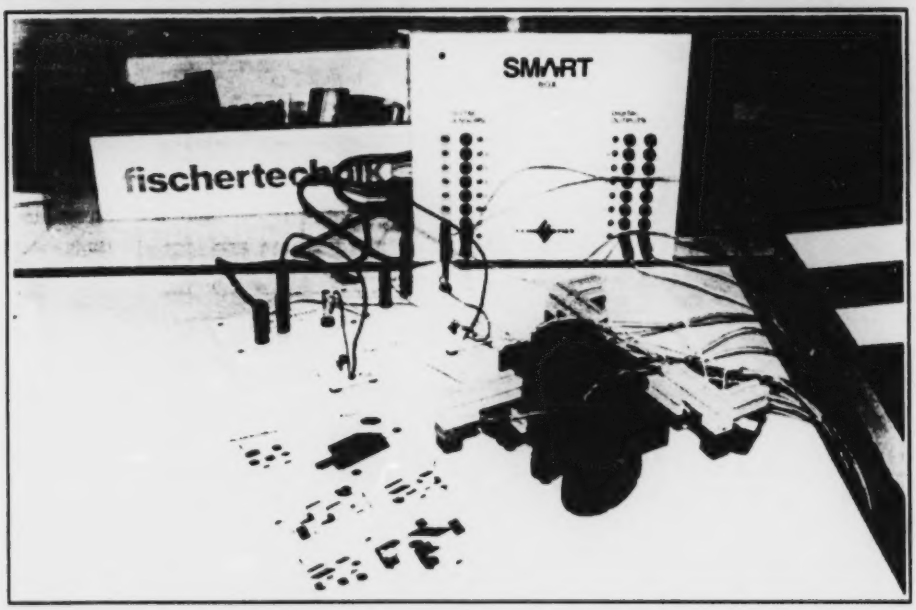
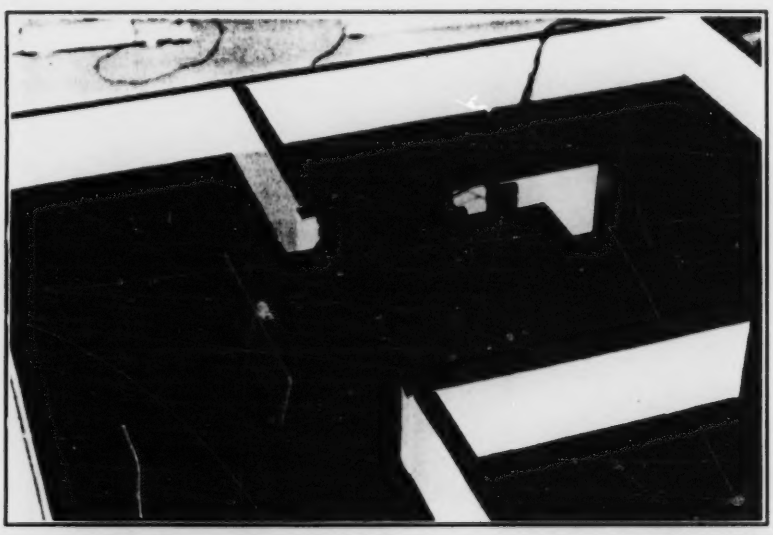


The modified Kickstart Buggy with side and front sensors fitted, wired to the Smart Box via User Adaptors

reliably. The sensors must determine when an obligatory manoeuvre is required, such as a 180° turn when a dead end is encountered (all three sensors indicate the presence of a wall), or a 90° turn when the front and one side sensor show the presence of a wall. The program must also keep track, using the counters, of the position in the maze relative to the centre. The third, and most challenging stage, is to develop maze-solving procedures so that the mouse seeks the centre when presented with choices in the maze.

We have also developed a quite different mouse design using a Fischertechnik Project 2000 kit but this approach has involved additional materials including roller bearings of the type that were used on the BBC Buggy. Development of this model is continuing. I am very impressed with the Economatics products we have used and, although they may not be adaptable to all the problems involved in mouse design, they certainly provide a good point of entry to the competition for beginners, like us!

There is still much work to be done and whether we will solve all our problems in time to participate in the Micromouse Championships at Bristol University on 11th July remains to be seen — watch this space! One thing is certain, however: that the pupils involved in this project are having a good deal of fun and gaining an excellent insight into control problems at the same time.



The basic Kickstart Buggy shown in the small maze section

For further information contact David Penrose, Computing and Control Division. IEE, Savoy Place, London WC2 0BL, tel: 071-344 5417, fax: 071-497 3633. The technical information pack, price £5, is also available from the IEE Computing and Control Division.

Details of Fischertechnik Kickstart and Project 2000 kits, and the Smart Box from Economatics (Education) Ltd., Epic House, Darnall Road, Attercliffe, Sheffield, S9 5AA, tel: 0742 561122, fax: 0742 439306.

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Focus on Initial Teacher Education

A 20-page feature illustrating the best of students' work in initial teacher education

Earlier this year, DATA's ITE Group sent a letter to universities and colleges in England, inviting them to contribute to this feature by describing the courses and facilities they offer and illustrating work done by their students.

What follows is a snapshot of the range of work covered in design & technology courses. Reading them, it soon becomes clear that although many courses bear the same title, each of them has an individuality, and each institution offers a different educational ethos. Some work shows the development of personal capability, some shows that of professional application, all of it shows the diversity of approach and outcome available within current courses.

In spite of repeated changes to the National Curriculum and the Technology component in particular, institutions have risen to the challenge and are clearly making every effort to ensure that those teaching D&T have the broadest possible education and experience. Most institutions evidently found it difficult to restrict themselves to the limits of space which this feature imposed, and would have found it a more pleasant task to fill twenty pages on their own. In addition to the work described, most institutions also offer a range of courses for both postgraduate students and in-service education.

Further information is available from all the institutions featured here; for more details, contact them at the addresses below.

Bath College of Higher Education
Newton Park
Newton St Loe
Bath
BA2 9BN
Tel. 0225 873701

Crewe + Alsager Faculty
Manchester Metropolitan University
Alsager Campus
Hassall Road
Alsager
Stoke-on-Trent
ST7 2HL
Tel. 0270 500661

Goldsmiths College, University of London
New Cross
London SE14 6NW
Tel. 081 692 7171

University of Greenwich
Avery Hill Campus
Mansion Site
Bexley Road
Eltham
London SE9 2PQ
Tel. 081 316 8000

King Alfred's College of Higher Education
Sparkford Road
Winchester
SO22 4NR
Tel. 0962 841515

Leeds Metropolitan University
Beckett Park
Leeds
LS6 3QS
Tel. 0532 832600

Loughborough University of Technology
Loughborough
LE11 3TU
Tel. 0509 263171

Sheffield Hallam University
Psalter Lane
Sheffield
S11 8UZ
Tel. 0742 532652

Westminster College
Oxford
OX2 9AT
Tel. 0865 251847

University of Wolverhampton
Dudley Campus
Castle View
Dudley
DY1 3HR
Tel. 0902 321000

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Bath College of Higher Education

The introduction of design and technology has given Bath College of HE the opportunity to diversify from training Home Economics teachers by developing courses for both primary and secondary D&T teachers.

All students on four-year primary BA/BSc. (QTS) routes follow a core professional module and an increasing number choose subject studies in this area for one or two years. Students who do two years' subject studies may also opt for a curriculum specialism in year 4. Primary PGCE students also cover some work in the area. Secondary students are on a PGCE route and are specialising in the textiles/food aspects of D&T although they also cover studies in the whole area.

Subject Studies modules attract students from a wide range of interests, backgrounds, skills and knowledge. Early projects are focused to develop understanding of the nature of design briefs and to introduce a range of skills and knowledge needed to work with a broad spectrum of materials. Students work individually and in groups and considerable progress has been made in methods of assessing individual contributions to group work.

Work described here represents subject studies in the first two years of four-year degree courses. Both examples are of group work in year 1.

❑ Food Technology: a group project

Brief: Develop a food product to be promoted in Bath or at a major event such as the Spring Flower Show or the International Music Festival

The City of Bath Council is concerned to promote employment opportunities beyond retailing and tourism. Groups of students carried out a market survey using Mintel and field work to identify a potential food product which would promote the production and sale of food in Bath. A range of potential products was developed and evaluated by consumer product profiling and sensory evaluation techniques.

Packaging designed and made by two groups of students: Sarah Higton, Louise Stubbs and Shelley Sutton (Bathonian Biscuits) and Lynda Parsons, Jill Veasey and Imla Venkatasamy (Bath Tarts)

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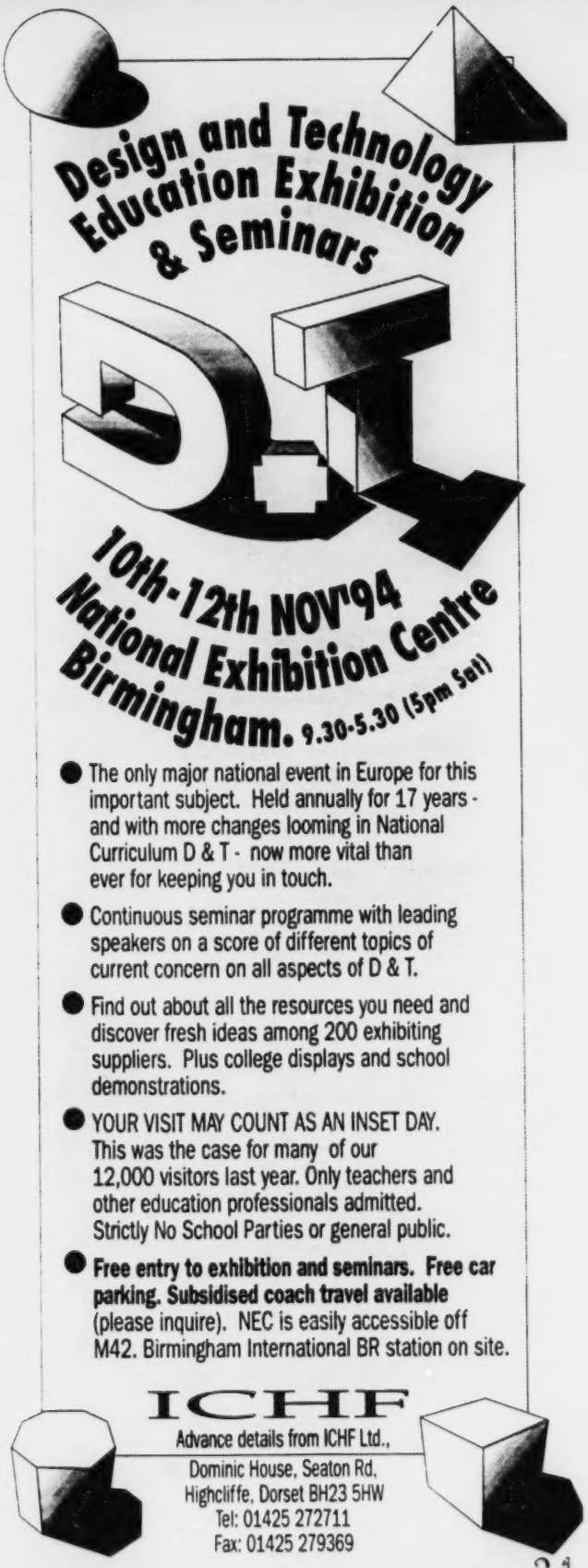
Design and Technology
Education Exhibition
& Seminars
D&T
10th-12th NOV'94
National Exhibition Centre
Birmingham. 9.30-5.30 (5pm Sat)
● The only major national event in Europe for this important subject. Held annually for 17 years - and with more changes looming in National Curriculum D & T - now more vital than ever for keeping you in touch.
● Continuous seminar programme with leading speakers on a score of different topics of current concern on all aspects of D & T.
● Find out about all the resources you need and discover fresh ideas among 200 exhibiting suppliers. Plus college displays and school demonstrations.
● YOUR VISIT MAY COUNT AS AN INSET DAY. This was the case for many of our 12,000 visitors last year. Only teachers and other education professionals admitted. Strictly No School Parties or general public.
● Free entry to exhibition and seminars. Free car parking. Subsidised coach travel available (please inquire). NEC is easily accessible off M42. Birmingham International BR station on site.
ICHF
Advance details from ICHF Ltd.,
Dominic House, Seaton Rd,
Highcliffe, Dorset BH23 5HW
Tel: 01425 272711
Fax: 01425 279369

Displays of selected products were photographed for use in marketing and promotion. Packaging of the product was designed and made to meet food labelling and packaging requirements and to contribute to marketing the product. Students (who were not necessarily food specialists) developed an awareness of industrial food product development and gained experience in some aspects of this. Packaging aspects of the project also developed students' IT experience through CAD and nutritional analysis programs.

❑ Mechanical Movement

For many students this is their first experience of design and technology. Groups of students are asked to design a display for a situation they have identified where moving elements can be incorporated to enhance the impact of 3-D presentation. The final design is made up as a working model (up to half a cubic metre) to attract attention and communicate information.

Other projects in year 1 develop skills in textiles and IT. Year 2 modules include work in resistant materials, systems and control and there is also an opportunity to carry out a personal project where the brief is negotiated by the student.

Mary Bagshaw

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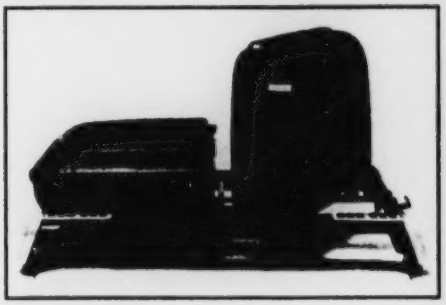
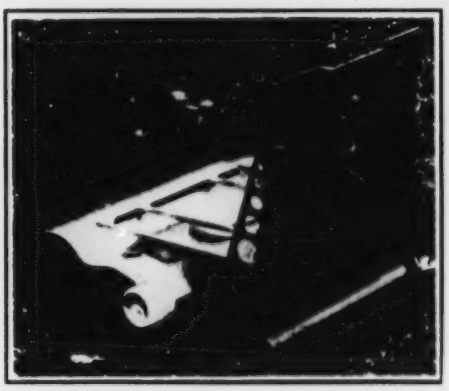
Crewe & Alsager Faculty, Manchester Metropolitan University

The work illustrated here is a representative sample from a wide range of design and technology activities undertaken on the BA (Hons) Secondary Education D&T, 2-year BEd. (Hons) and 2-year PGCE courses at the Crewe & Alsager Faculty. All students are taught by a range of practising professional designers/technologists and tutors with experience of teaching D&T in schools, thus providing a healthy balance of professional expertise.



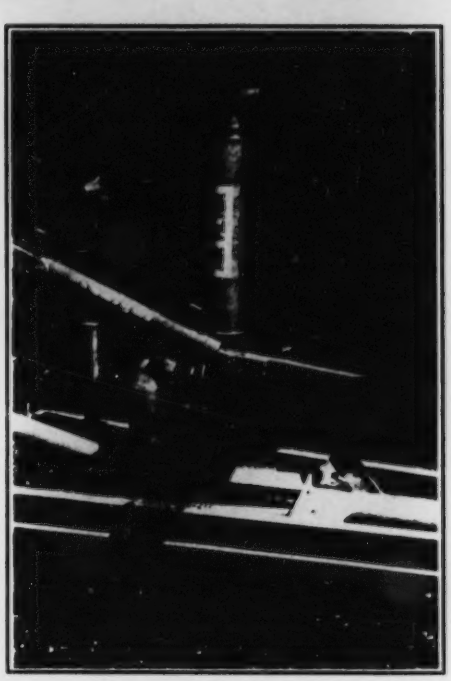
Integrated luggage rack by Michael Blakeman

This is designed to integrate the car roof-rack system with purpose-made luggage so that the two fit easily and safely together. The project was undertaken with a major manufacturer of roof-racks together with Carlton, manufacturers of quality luggage containers. The design incorporates a number-code lock which secures the luggage to the rack.



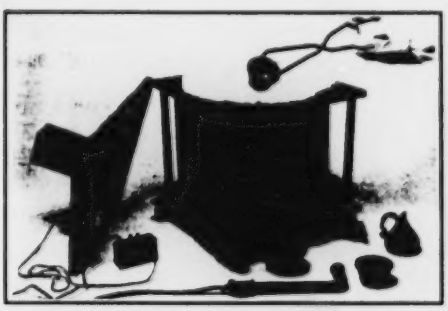
Its a Gas! — a portable gas cooker designed by Sarah Mintey

This staff-initiated project required students to create a concept model for a portable gas cooker which could be used in a variety of situations. Sarah demonstrates here how product styling, ergonomic and user aspects were considered alongside technological and manufacturing requirements to meet a specification and thus a viable product proposal.



Slurry aerator by Jeremy Kneller

This is an attachment to a standard Malgar slurry stirrer and comprises a pulley-driven blower forcing air down the propeller shaft casing and out at the impeller. The purpose is to aerate cattle slurry whilst it is being stirred. The helps to fix the nitrogen and prohibit methane-generating bacteria.



Josephine Martin's Raku kiln for primary schools

Teachers are often reluctant to build home-made raku kilns for safety reasons particularly when they are for use by young pupils. This kiln is safer, easy to operate, portable and relatively inexpensive to manufacture. The design and development were support by BVK Furnaces and Combustion Linings, both of Stoke-on-Trent.

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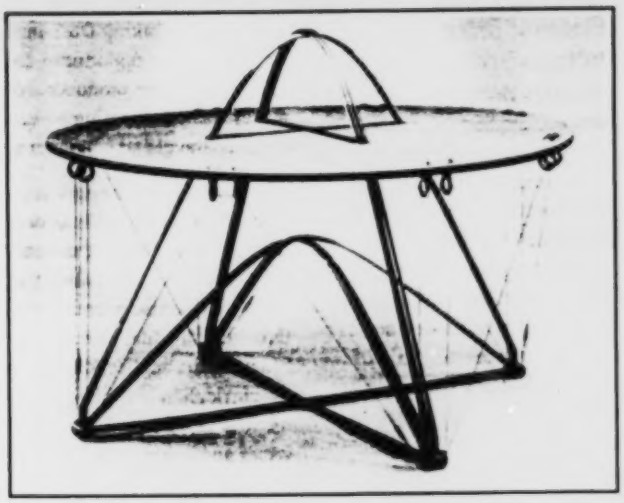
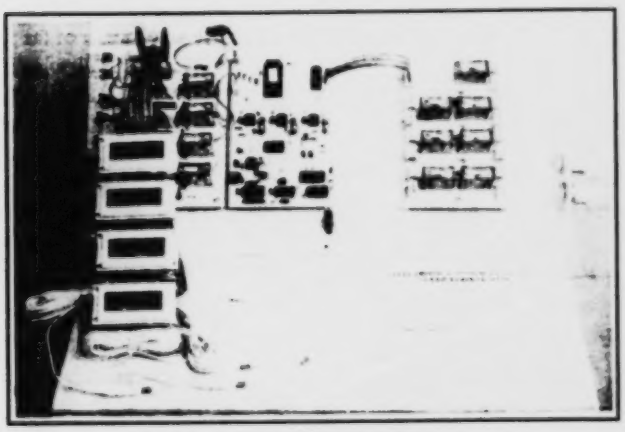


Tensile structure by Sarah Whitcutt

This low-level table demonstrates risk-taking to create an unusual solution to a familiar problem. It sensitively balances both visual and technological elements in response to a staff-initiated project based on tensile structures.

Jardinière by Bridget Elton

This is an example of staff-initiated projects for first-year students, designed to enhance students' understanding and experience so that they learn to use materials with imagination and discrimination.



Heating and ventilation system for a bean sprout unit by Gerald Wright

The growing of bean sprouts is a risky business, requiring particularly fine control of temperature and air change. Gerald's project included the design and manufacture of the heating and ventilating units made from galvanised steel, the electronic control system illustrated here, and the software to make it run.

Mark Harris's design for a two-seater light helicopter

The design features a 200 hp rotary engine using composite technology including a pilot/co-pilot crash cell. These features plus many other design innovations are hoped to lead to an affordable two-seater light helicopter.

R. G. Robinson

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Goldsmiths College, University of London

Goldsmiths has involvement in a wide range of teacher education courses, both at initial and continuing professional development levels. In the Design Studies department this includes four-year BA in Education courses for both potential primary and secondary teachers and a one-year PGCE secondary course. All courses are linked into the Department of Education Studies, tutors in Design Studies covering D&T subject study and curriculum application courses.

❑ The BA courses: linked work and specialist work

The BA courses (Primary BA (Ed.) in D&T with Computer Studies, and Secondary BA (Ed.) in D&T) recruit from a wide range of backgrounds. With its strong community education links, Goldsmiths has always been interested in encouraging mature students as well as those with more traditional qualifications such as A levels and one of the strengths of these courses is the broad and relevant expertise within the exciting mix of students on course. The two courses have many similar features and for much of the first two years of subject study the students are taught in one group. This is enriching for both groups and helps to build mutual respect for each other's skills in their specialist subject. Both years of the course are context led and students are required to look beyond the designing and making of artefacts. They research into and examine the issues of D&T activities and the contexts they follow include body adornment, storage, alternative energy, electrical and computer control.

Other parts of the two courses run separately. The primary students develop considerable skills in computing and the use of IT which has involved working in partnership with local industry as well as taught courses in computer applications and techniques. In the final two years of the course they study in more detail approaches to taking D&T into the classroom, giving them the opportunity to apply their own knowledge in the production of teaching resource packs focusing on such topics as puppets, travel and computer control.

Two students working on an alternative energy project centred on the use of active solar water heaters

Students on the secondary route continue to develop their own skills as design and technologists into the third and fourth years of the course. This work allows students to develop expertise in areas of specific interest through individual choices of major projects. Studying the application of their subject into the curriculum is a thread that runs throughout the four years, studying general educational issues and linking their D&T understanding and capability with school-based work. An education report in the fourth year gives students the opportunity to bring the many threads of their subject and professional studies into a piece of work focusing on a specific area, such as teaching and learning, equal opportunities or assessment.

❑ Project example — Alternative energy

During the second year of the joint subject study, the students work together on the theme of alternative energy. This includes the study of a full range of non-fossil and non-nuclear energy sources and the transformation of such generated energy for useful purposes. Students undertake a self-selected special study resulting in a report and they design and make a working model of an alternative energy system.

Student projects have included aero generators using cycle hub dynamos, passive solar systems, redesigning houses to capture and keep energy from the sun, active solar water heaters using hosing or piping in insulated glass-topped boxes, photovoltaic cell powered vehicles, wave and tide powered electricity generators and compost-heap heaters and generators.

A major concern of ours is to work in partnership with both internal and external agencies. This includes research projects within the department, the college and external partners. These partners help define the context of all the work, provide invaluable information resources, serve as clients for some of the student projects and quality assurance collaborators in planning, teaching and evaluation of the course.

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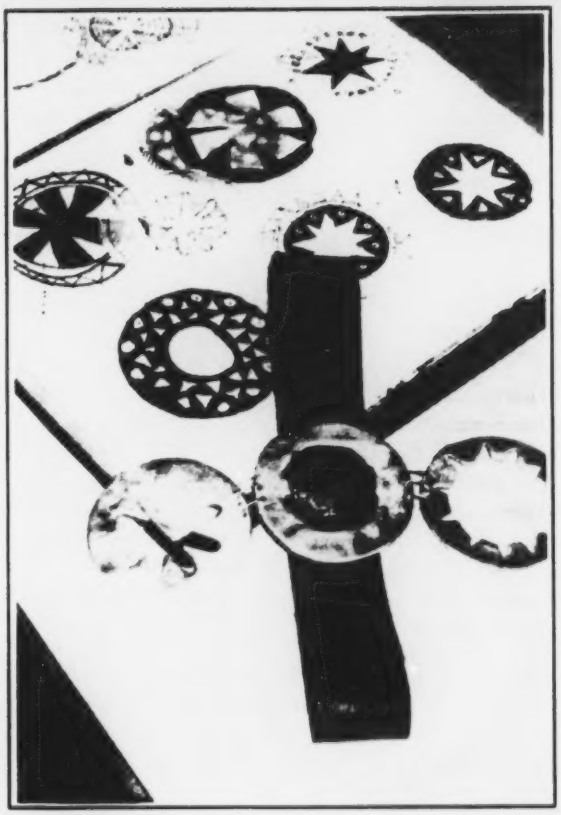

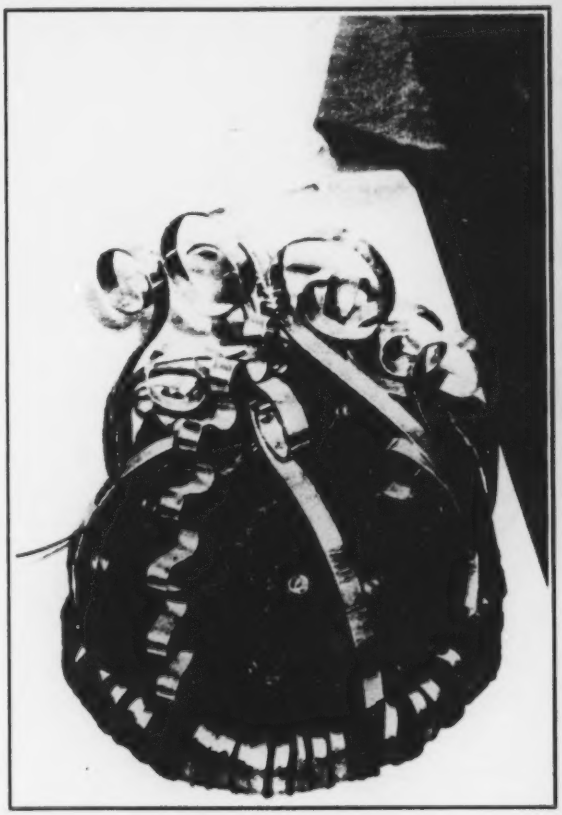

Two of the artefacts designed and made on the theme of body adornment

❑ The secondary PGCE course in Design & Technology

The PGCE programme recruits graduates from a wide variety of D&T related backgrounds. There are currently 28 students on course and it is run as a Teacher Training Partnership between Goldsmiths and fourteen schools in and around London.

College-based work concentrates on developing students' understanding of the educational context and expertise in the field of D&T. Experiences are designed to provide students with a wide variety of construction and control activities. Additionally students are required to engage in a design and make task. The project-based assignment undertaken by students on this year's course required them to design and make an artefact based around the theme of body adornment in the context of other times or cultures. Students were given freedom to generate and develop their design ideas using a variety of approaches and the outcomes from the activity were imaginative and of a very high standard, reflecting the expertise PGCE students bring to education from their degree courses and industrial/ business experience.

The Design Studies department also runs an MA in Technology and Education and, through TERU (Technology Education Research Unit), an extensive portfolio of D&T and IT courses for the continuing professional development of primary and secondary teachers.

Dominic Clare, Terry Liddament, Maggie Rogers, John Saxton and Kay Stables

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The University of Greenwich

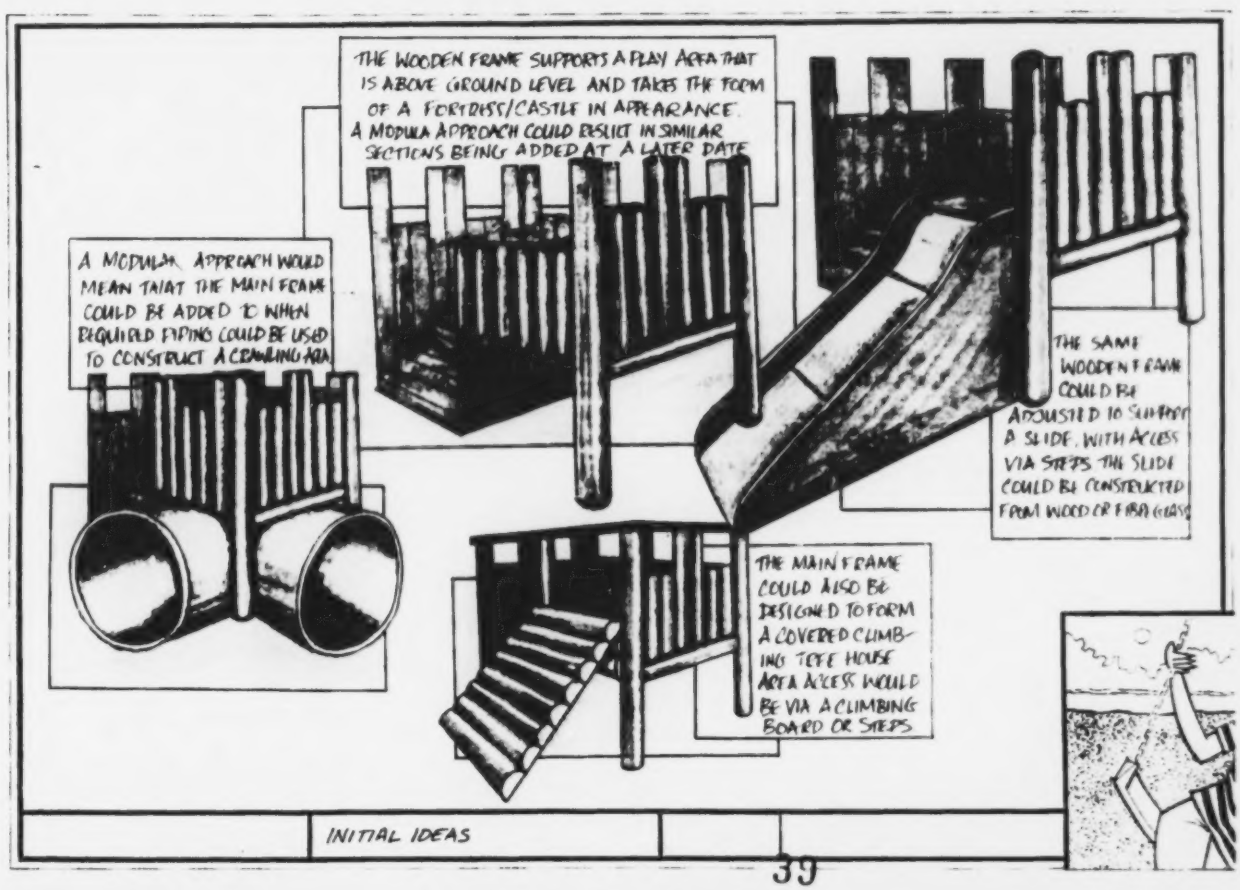
As with all training establishments, it is our intention to provide student teachers with the experience, expertise and opportunity to develop an innovative approach to the teaching of Design Technology through a series of developmental, subject-specific projects. One aspect of our philosophy encompasses a broad vision of design education where creative problem-solving tasks are, as far as possible, based in the real world and deal with recognisable situations which have the potential to be related to pupils in school.

All coursework is structured into a series of overlapping and inter-related activities centred upon our requirement that students engage in and respond to a wide range of tasks associated with product analysis, design and manufacture. We endeavour to create a supportive learning environment where individual students can gain in confidence, progress and improve the quality of their own design and technology.

All our undergraduates spend the first three weeks of the course undertaking a series of short teamwork projects. The introductory unit not only provides many students with a first taste of problem solving but also encourages peer group co-operation, the public sharing of ideas, and the ability of students to think on their feet. Importantly for all concerned, it also acts as an icebreaker, quickly establishing a positive, enjoyable working environment for designing and making which crosses course boundaries. Such group work offers scope for tackling many issues associated with both subject and professional development.

We feel strongly that our students should not only experience working closely with the community but should also see how such a focus could be applied to their own school practices. This enables them to interpret and deliver National Curriculum Technology through a range of viable and stimulating contexts.

The Social and Environmental project presents a situation where design teams liaise closely with a client who has identified a number of potentially solvable problems; these contexts are analysed to establish a viable project which can be fully realised to meet a specific need. Quite often this entails developing tight


THE WOODEN FRAME SUPPORTS A PLAY AREA THAT IS ABOVE GROUND LEVEL AND TAKES THE FORM OF A FORTRESS/CASTLE IN APPEARANCE. A MODULA APPROACH COULD RESULT IN SIMILAR SECTIONS BEING ADDED AT A LATER DATE
A MODULAR APPROACH WOULD MEAN THAT THE MAIN FRAME COULD BE ADDED TO WHEN REQUIRED FIXING COULD BE USED TO CONSTRUCT A CRAWLING AREA
THE SAME WOODEN FRAME COULD BE ADJUSTED TO SUPPORT A SLIDE. WITH ACCESS VIA STEPS THE SLIDE COULD BE CONSTRUCTED FROM WOOD OR FIBRE GLASS
THE MAIN FRAME COULD ALSO BE DESIGNED TO FORM A COVERED CLIMBING TEPEE HOUSE AREA ACCESS WOULD BE VIA A CLIMBING BOARD OR STEPS
INITIAL IDEAS

Student's design for the play centre

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Children playing in the new log cabin

The single-span bridge to enable pupils (including those in wheelchairs) to enjoy pond-dipping

organisational and management skills to enable students to work within and manage substantial project budgets which have been raised by clients through associated fund raising or sponsorship.

The 20 Social and Environmental projects during 1993-4 have included:

- A play centre project; this not only involved students in proposing and modelling design solutions to the community but also evolved into a co-ordinating and management role to optimise the involvement of a number of agencies, the local committee, the local authority, TEC and various companies to effect a radical redesign and refurbishment of the complete interior. This included relocating walls, fitting services, redecoration, double glazing, re-carpeting, and re-equipping the centre. The successful project prevented closure of an under-used facility by transforming it into a valuable community asset.
- A local primary school asked us to provide a team to design and make an outside play/learning area for their infant pupils. This needed to be an attractive and welcoming environment to pupils, provide shelter from the elements and simultaneously satisfy the needs for safety and supervision. Our design team presented a range of possible ideas and eventually designed and built a log cabin enclosure to meet all the specifications set by the client. The completed structure was finished to such a high standard that the LEA was prompted into sanctioning additional improvements to the existing, rather dilapidated school buildings.
- Another group of students worked closely with a local environmental centre, eventually accepting a brief to provide disabled access to a pond area. However, the pond had an existing plastic lining to prevent the use of any supporting pillars, which posed a number of design and construction problems which had to be overcome. The resulting nine-metre, single-span steel bridge was designed and built to enable pupils (particularly those confined to a wheelchair) easy and safe access for observation and pond-dipping purposes.

Not only do these projects require considerable imagination and ability on the part of the design team, they depend on combining shared goals with workable structures across design/production and academic constraints. Students draw heavily on prior experiences as well as personal and inter-personal skills in order to meet the obviously high expectations (including health and safety legislation) of all concerned. They can no longer rely solely on a prototype, a concept model or something that looks amazing on paper; the solution has to live up to real, operational criteria as well as satisfying the assessment requirements of the University.

It is encouraging to see our graduate and postgraduate teachers successfully managing group projects within both primary and secondary schools. We believe that this approach provides enhanced opportunities for our students to not only develop their competency as creative teachers of D&T but also be innovators capable of active involvement in the future evolution of the subject area.

John Durrell, James Golden and Ken Webster

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King Alfred's College of Higher Education, Winchester

The department of Design & Technology forms part of the School of Science and Technology, and is housed in purpose-built accommodation in a single building on the campus. This is a thriving and friendly place to work, with eight full-time members of academic staff some of whom come from backgrounds in product and interior design and others from primary and secondary education. Recent developments include successful design consultancy work for industrial clients, and a move to a closer relationship with the College's Art & Design department. New courses are also under development, including fields in Product Design, Concurrent Engineering, and Technology & Society for the Modular BA/BSc., and new teacher education courses to meet the changing demands of the subject.

Four major courses are currently offered, three of them concerned with teacher education. All have a strong practical foundation and offer opportunities to work on both individual and group projects to develop a range of skills in designing and manufacturing products. While each course is distinctive in its own right, students also benefit from meeting the whole spectrum of skills and approaches brought by colleagues on other courses, through modules and course elements which are jointly taught. Thus, students following the BA in Design & Technology share work in their first year with students on the 2-year BEd. course, and in their final year share Technology & Society modules with final-year students on the BA in Primary Education. Use of the open-plan workshop encourages students to discuss work in progress with each other as well as with tutors and demonstrators. The wide variety of possibilities of work in this area is summed up in the words of one new graduate: 'The broad base gives you a good grounding . . . there are so many sorts of designing, you need to have flexibility'.

A Design & Technology Field is offered in the College's distinctive Combined Studies Modular BA/BSc. This Field can be taken in a variety of combinations, as Single Honours, or combined with other Fields. Students who think that they might be interested in a teaching career at a later stage can combine their studies in D&T with work in related fields such as art and design, or computing, and/or with modules from the Education Studies Field. Others can choose combinations from a wide range including Japanese Studies, Popular Culture, and Drama and Television.

The 2-year BEd. caters specifically for mature students with HND or equivalent qualifications and industrial experience, who wish to become secondary teachers. The course enables students to gain experience and skill in a broad range of areas of D&T, while they develop the necessary professional skills through Teaching Methods courses run by partner schools, followed by extended school placements.

A water safety device designed by Janice MacDonald, a third-year BEd. student, to help mothers taking both a toddler and baby to the pool; it supports the baby safely whilst leaving the mother's arms free, and the design is being taken up by the manufacturer who sponsored the project

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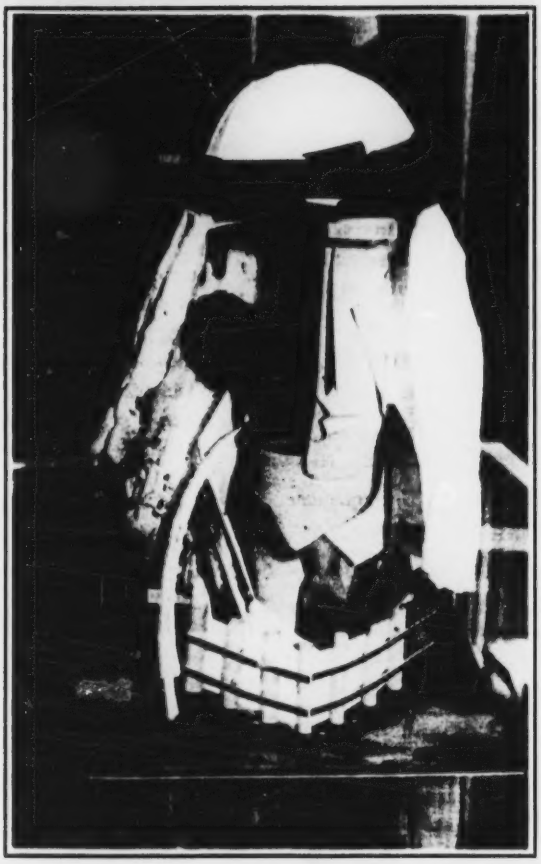

A project in communication and modelling by first-year BA in D&T student Kevin Flett, representing T.E. Lawrence and showing both his assumed persona and his self-destructive personality

The BA in Design & Technology with Certificates in Education or Industrial Studies is a unique course, which gives students the chance to try out working in both education and industry before making a choice of career path. The first two years include placements in secondary schools and in industrial organisations. Students who do not wish for a career in teaching may opt at the end of the second year to follow the Certificate in Industrial Studies by taking an additional project and an extended industrial placement, while those who continue with the Education Certificate have additional Professional Studies courses, and further school placements.

The BA in Primary Education offers a well-established Main Subject Option in Design & Technology. Work in the subject covers aspects necessary to primary teachers such as mechanical and electronic systems and computer control, and also allows individual exploration of areas of personal interest in years 3 and 4. Five modules of this course are devoted to aspects of teaching D&T in primary schools, and include opportunities to try out activities with groups of children in local schools.

Bridget A. Egan

A group project in year 3 of the BA in D&T course, producing a working prototype and its packaging to support teaching primary pupils about light

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Leeds Metropolitan University

We offer a wide variety of routes and specialist combinations to students wishing to qualify as teachers of design and technology in either the primary or secondary phase. Courses have been rewritten to cater for the ever-changing needs of the evolving National Curriculum Technology. Students have to demonstrate capability in designing and making skills and a commitment to teaching before selecting the route which best suits their particular needs. We offer:

- PGCE Secondary DT or DT Home Economics (1year full time)
- 4-year BEd.(Hons) Secondary Undergraduate Modular Scheme (full time)
- 2-year BEd. Secondary Undergraduate Modular Scheme (full time)
- PGCE Primary (1year full time)
- 4-year BEd. (Hons) Primary DT Route (full /part time).

Students enjoy opportunities to work in a wide range of media and materials including resistant materials, food, textiles, graphics and IT. A profiling system is in place which records their progressive practical achievements and their acquisition of competence to teach the subject.

Major Projects form a focal point on all our courses and provide an opportunity for students to demonstrate the progress they have made as designers and makers themselves. Students are encouraged to identify real needs and design and develop solutions to that problem, aiming for the highest levels of practical achievement and quality of finish.

Curriculum Research and Development in year 4 provides the student with an opportunity to engage in school-based research and a chance to develop a teaching and learning project which really does meet the demands of both the teacher and the pupils in a particular classroom. The final trial and evaluation of the work has to be completed by the teacher and pupils for whom it was designed. Students this year have been engaged in a diverse range of projects as the changing focus of the NC has been a rich context for curriculum debate and development. The teaching of basic skills in food, textiles or resistant materials produced interesting results which won praise from school staff as a starting point often ignored by some sophisticated schemes.

Provision for KS4 and GNVQ within the context of industrial food production provided Michelle Pearson with the opportunity to demonstrate the implications of food technology within the curriculum using an industrial focus. Food was used creatively as a material for designing and making high-quality food products but retained the important key features of nutrition, physical and chemical properties and sensory appraisal.

This creative project involved exploration of textile construction, testing of materials, pattern drafting and embellishment techniques. Textile projects enable students to gain skill and confidence in creative enhancement techniques and manufacturing processes.

The Control Technology module focuses on the role of control within society, particularly in the manufacturing and the service industries. Research of both automated and manual systems provides reference for construction of a computer-controlled model which simulates such a system.

Mick Orton identified an elderly relative's more immediate need for an enlarged, stable remote-control unit to use for TV and video; he worked in plastics using CNC facilities and electronics.

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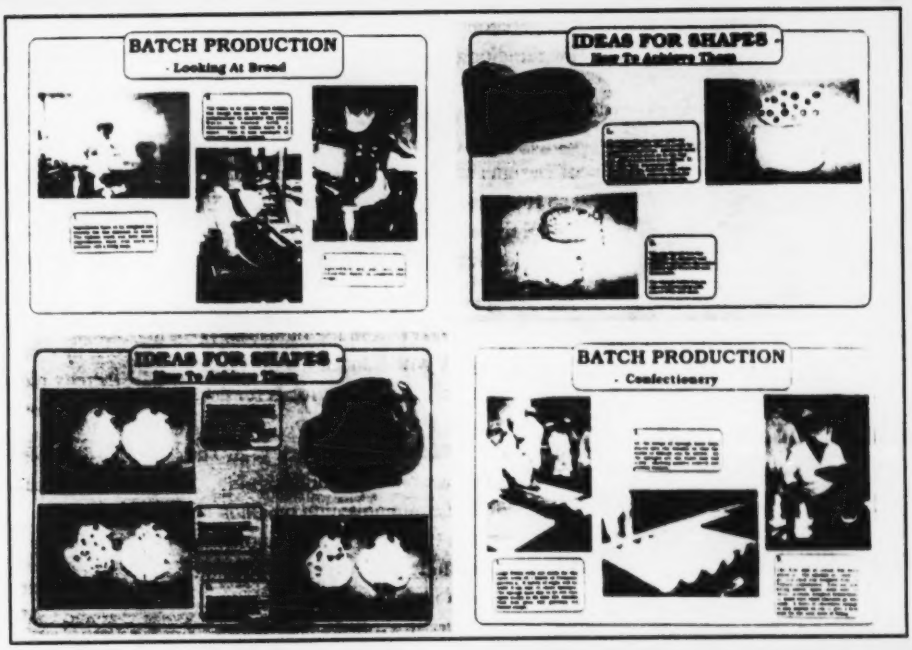
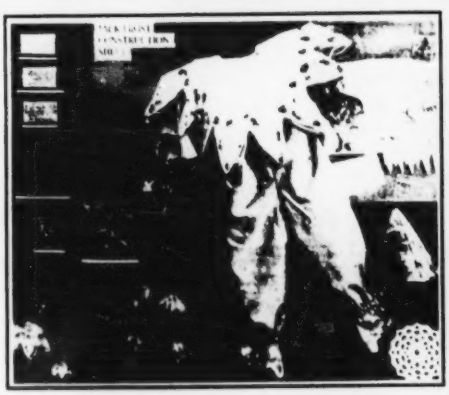
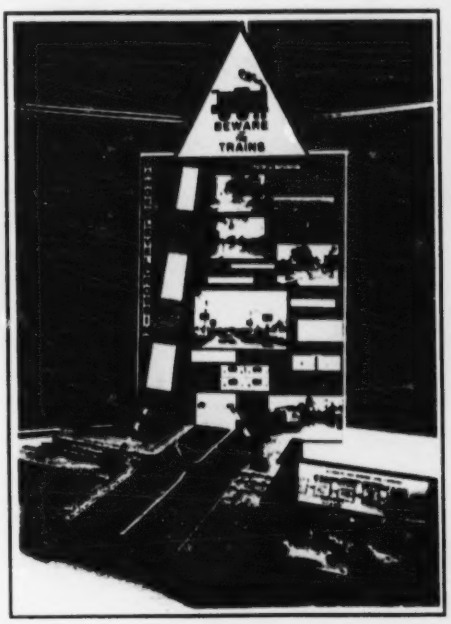
Food batch production in action. The successful outcome was a dual route at KS4, GCSE/GNVQ and partnerships between school and FE at an early stage.

Below right: Andrew Riches' model shows an automated railway crossing, which not only operates the barriers and alarms upon the impending approach of the train but also monitors the crossing for obstructions and stops or diverts the train. Other projects explored preservation and protection of museum artefacts and testing and selection of fresh fruit and vegetables.



The Jack Frost Fantasy costume was designed for a nursery aged child by Julie Hemming on year 4 of the DT HE route





Fiona Hird looked at Saltaire as a starting point for a collaborative project involving historical, artistic and commercial dimensions of the venue. The pack contains all you need — maps, itineraries, slides, worksheets and starting points for focused D&T activities back in the classroom.

Our post graduate students spend two thirds of the year in school. This is not just an extension of teaching practice but a chance through our partnership scheme to work with school mentors on both the expansion and application of subject knowledge.

An assignment in subject application focuses on the increasing need for pupils to observe and engage in D&T activities outside the classroom. It also serves to introduce students to the rigours and responsibilities of planning, developing and implementing learning activities in alternative venues. It enables students to become familiar with the resources the local environment can provide for D&T activity.

Denise Gilchrist

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Loughborough University of Technology

Loughborough University of Technology has a long tradition of initial teacher education in the area of design and technology. Following the University's amalgamation with Loughborough College of Education in 1977, the Department of Design and Technology now provides three- and four-year degree courses together with a PGCE route for students with an appropriate design degree.

The student work illustrated here represents major projects taken from the Industrial Design and Technology with Education course. This four-year course is the major focus for design and technology ITE at Loughborough and recruits around fifty students each year. The course develops a capacity for designing, production and communication which is consistent with the needs of professional designers. An understanding of the educational values inherent in these activities is brought out through work in Professional Studies modules which relate the students' broad range of designing and manufacturing skills to the needs of National Curriculum Technology teachers.

These client-based projects present an opportunity for students to present their design ideas as working prototypes which integrate elements of engineering design and product design with appropriate technologies. This provides a sound platform of designing and technology skills from which Professional Studies and Education Studies modules develop the skills required of Technology teachers.

The Tetra Classic Cap, designed by Dave Vellacott, a 3rd-year student of Industrial Design with Technology Education, to allow resealing of aseptic food cartons

The Tetra Classic Cap was designed to allow the resealing of aseptic food cartons to make it feasible to package such foodstuffs as mayonnaise and sauces in Tetra Pack type containers. A central challenge for this brief was to produce a cap that could be integrated with the current production process with as few modifications as possible. The solution devised is attached to the packs during the production process. The original polythene seal is broken when opened by the consumer, and the carton can then be resealed via this plastic cap, thereby reducing the deterioration of the contents and preventing spillage.

To allow the design to be fully evaluated, Dave prototyped his solution as an injection moulding. This required the use of CNC machining to produce the mould tool:

> My course covered a variety of materials and CAD/CAM systems during the first two years. This was of great assistance in the design and manufacture of my third-year major project for Tetra Lavel Food when I needed to produce an accurate injection moulding tool using CNC equipment. I expect to be teaching CAD/CAM at my next teaching practice school.

Intended to be used in conjunction with two satellite speakers, the Sub-Woofer Amp provides a combination of amplifier and low bass speaker. The low-frequency response of the unit enables it to be positioned anywhere within a room to give the effect of surround sound. As a project combining visual and a technical element, Andrew chose to model his design as a fully working prototype. This required the integration of vacuum formings and plastic fabrications to give the appearance and structure of an injection moulding:

> Working with a client like Cannon Audio meant that I was treated like a professional and was able to draw on all my skills as a designer to produce a working prototype for my presentation. I felt confident working in schools because of my strong background in graphics, design practice and information technology and the client experience will help me to provide an industrial insight for pupils.

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Fraser Warren's Vertex back-pack system was developed in conjunction with Vango as a cost-effective means of accommodating differing back lengths, carrying relatively heavy loads, and allowing the circulation of air around the back.

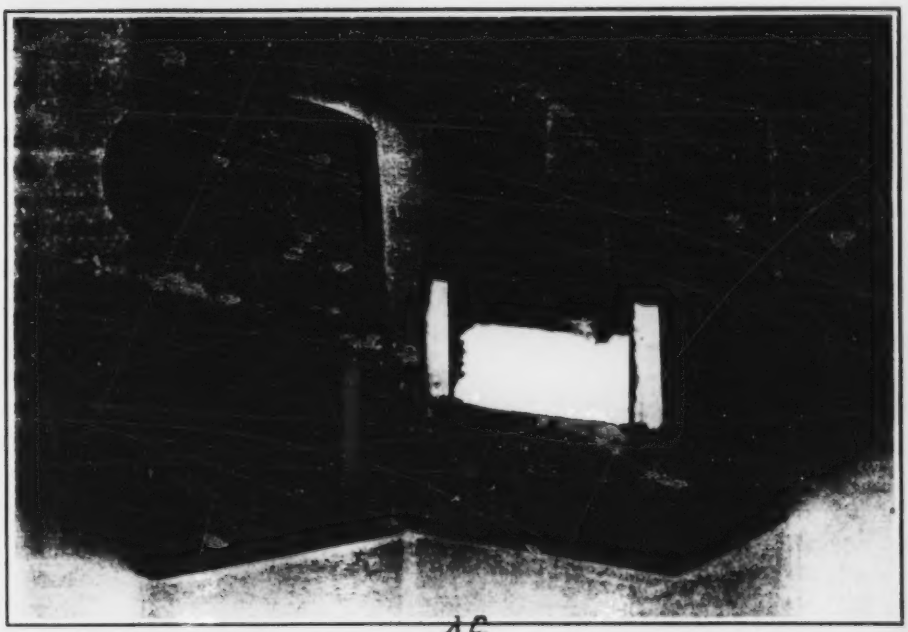
Following extensive development and testing, the solution incorporates a rigid polymer and aluminium frame to which the shoulder straps, pack and belt are attached. Adjustments to the length of the frame are made using a simple locking mechanism. This allows changes to be made, not only for differing back lengths, but also for the easy shifting of pack position due to differing walking conditions. The wide experience Fraser had gained during his course paid dividends:

> Vango, my client for the third year major project, were impressed with the range of materials I was able to work with. I found, on my last teaching practice, that this is consistent with the needs of pupil project work in schools.

Mark Evans and Tony Hodgson

The back-pack system designed by Fraser Warren, a 3rd-year student, Industrial Design and Technology with Education

The Sub-Woofer Amp designed by Andrew Buck, a 4th-year student, Industrial Design and Technology with Education



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Sheffield Hallam University

Design & technology education takes place in the School of Cultural Studies where students following teacher education courses have access to the wide range of facilities available to all students studying design subjects. Specialist facilities are also available for professional aspects of courses. We offer the following courses:

- Three-year BSc. or BSc.(Hons) in Design & Technology with QTS for students with A level or BTEC qualifications
- Two-year BSc. or BSc.(Hons) in D&T with QTS for students with HNC/HND qualifications
- Two-year PGCE for students with a degree not directly related to D&T, such as Fine Art or Computer Studies
- One-year PGCE for students with a degree related to D&T, such as Product or Industrial Design.

A child wander alarm designed by Suzanne Robinson as her final project in a 4-year BEd.(Hons) course

The following examples illustrate the range of project work covered in our courses.

A child wander alarm

Several companies manufacture systems which warn parents when a young child in their care wanders off; these alarms work satisfactorily, but the parent is left looking for the child, who is unaware that he/she is lost. This obviously makes children vulnerable to abduction. Suzanne's system features an alarm on the child's apparatus too, so that once the child has strayed, the alarm sounds on both the parent's transmitter and the child's, alerting the child (and other adults in the vicinity too). The system consists of a binary coded radio link with a preset transmission range of 30-40 metres in built area and up to 60 metres in the open. The child receiver belt consists of the battery pack, receiver, decoder and alarm.

Baby Box

The baby box was designed to meet the need for a portable unit to assist babies with breathing difficulties. The project was a joint venture with Sheffield Children's Hospital, since although portable units do exist, they offer poor ergonomics and access to the baby. Following consultation this design emerged, offering access not only through the circular side hatches, but also via the top and front if necessary. As this project is medical, the quality of manufacture had to be to exacting standards, with the acrylic polished to a fine finish, for example.

Canoe Paddles

Existing canoe paddles are shaped to provide an effective push against water, and although they work well when propelling the canoe forwards, they can only be used in reverse if they are rotated through 180 degrees. This project explored both paddle design and materials and resulted in a frame for the paddle blade with a flexible diaphragm held in tension. When in use, the diaphragm distorts to produce a spoon shape, improving the efficiency of the blade. As the diaphragm can flex in both directions, it works equally well for backward and forward motion. The frame is made of carbon fibre and resin material with sheet neoprene for the diaphragm.

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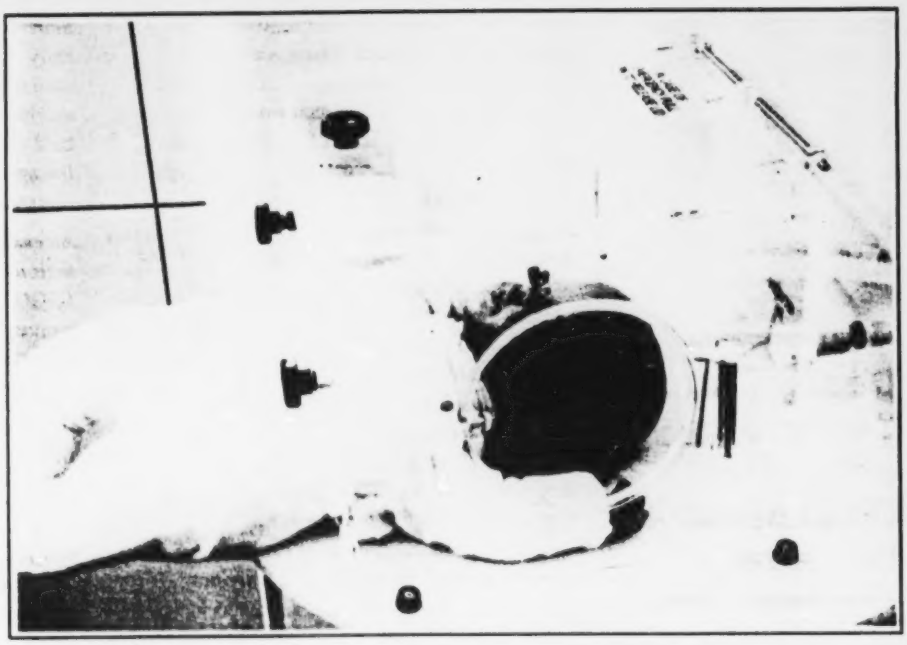
Baby Box by Don Brunsdon, a student on the 2-year BEd. course

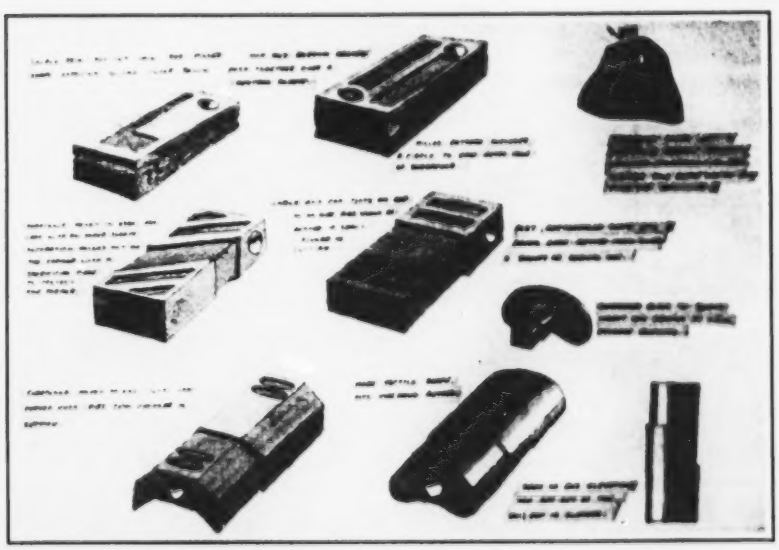


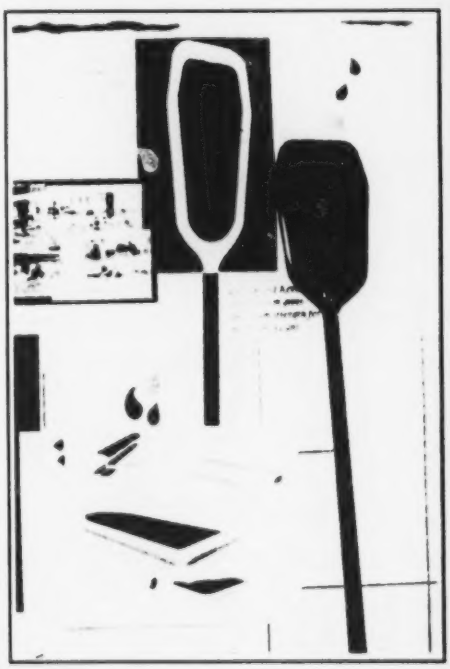
Pencil Sharpeners

The starting point for this project was a plastic pencil sharpener which had to be incorporated into a casing to hold the shavings. The emphasis was on producing an attractive product using techniques readily available in school — in this case, vacuum forming. The illustration shows some of the design work for the final product, which was made by vacuum forming over an MDF former, with the lid also vacuum-formed over the body of the sharpener. This ensured accurate fitting of the two parts, and the method has been used successfully by pupils.

Tim Lewis

A project by Andrew Blackshaw, featuring pencil sharpeners, for his INSET BEd.





Des Jones's design for a canoe paddle, the final project in his 2-year BEd. course

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Design and Technology at Westminster College

Westminster college trains BEd. students to teach in primary schools. There is a 40-hour optional course for students in Part One (years 1 and 2) of the degree. The students therefore come to us with a variety of backgrounds, and only a few have studied design and technology. In Part Two (years 3 and 4) we teach the professional studies aspects of design and technology to all students. Students have twenty hours of lectures to prepare them to become teachers of D&T. The course has firstly to familiarise the students with the National Curriculum orders and then to show how to implement them. The course is practically based with students learning skills, techniques, knowledge and understanding as they move from focused tasks to tasks where they can design and make things for themselves. The college has an excellent resource base where students can carry out research for their own designs as well as topics to use on their Block School Experiences. We hope that through their own enjoyment of designing and making, students will be able to engender this in their pupils.

We teach ten 2-hour focused sessions:

- *The nature of technology and the National Curriculum Orders.* We examine objects both old and new to show that there is nothing fresh about technology as it has been with us for hundreds of years.
- *Starting points for technology.* The use of story books, for example. Students are read the SAT story *A Greeting for Marcus* and have to design and make a pop-up card. We teach the use of levers and linkages which can be included in their designs in they wish.
- *An evaluation of construction kits and their use in the classroom.* We examine LEGO and DUPLO, and the associated workcards in detail. Students are taught about belt and gear drive.
- *Making a wooden Jinks frame as a chassis for a buggy.* Students are also required to make it move across the room, powered in any way that they wish to try.
- *Food technology and the development of a new flavour of yoghurt.* We show the links between technology and EIU as students have to set up their own companies to market their product.
- *The study of cams and cranks to achieve different types of movement, and the use of pneumatics and hydraulics to operate simple mechanisms.* Students carry out a design and make task using one of these mechanisms.
- *The study of different types of structures and the properties of materials.* We look at various methods for joining materials, and building and testing bridges and towers.
- *Designing and making a puppet using textiles.* Groups of students also have to present a short play.
- *Energy choices with particular reference to electricity and simple electronics.* We look at the design of various types of switches and circuits.
- *Cross-curricular links and the development of integrated design and make tasks.* Students select their own topic and research ideas for D&T which can come out of the topic.

Year 5/6 Home Design

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Throughout all sessions we emphasise the safety and hygiene aspects of the work. We also look very carefully at the National Curriculum documentation to show how the ideas covered are appropriate for different age groups. Students are provided with information about differentiation and ways to assess pupils' work. They are encouraged to go into schools and try out the activities they have developed and reflect on these in future workshop sessions.

The photographs show work carried out by a student on school experience using ideas from the college course. The pupils in Years 5 and 6 were studying the topic Homes and had been looking at the buildings and houses in the surrounding area. The student wanted to link electrical work and the building of frame structures into the topic. The pupils had already carried out work in simple circuits in a previous class and were reminded of this at the beginning of the project. They were also shown how to make a wooden frame with triangular card corners to strengthen it.

Many pupils decided that they wished to have more than one light in the house and needed to explore series and parallel circuits. They needed to turn the lights on and off and had to design switches to do this. Some children made various types of burglar alarms with pressure pads to go under carpets or switches which operated when doors were opened.

Having decided which circuits to build, the pupils had to design the house and select materials appropriate to the task. In the example the pupils designed a living room with card walls and underlay for the roof. They built furniture for the room and decided that they wanted a fireplace. They made the flames out of tissue paper and then placed a bulb behind this to show when the fire was burning. The project took a long time to complete but as can be seen from this finished house, the pupils produced work of real quality.

David Coates

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University of Wolverhampton

The Centre for Design and Technology Education (CDATE) is part of the Faculty of Education at the University of Wolverhampton and has superb accommodation for students wishing to study D&T as a single subject at BA and MA levels or as part of a teacher training BA degree. CDATE operates with a comprehensive range of resources, skills and experience to help train students for a challenging and exciting career. In the midst of unprecedented change in education, the CDATE continues to move ahead with innovative programmes, including courses which have gained outstanding quality status. CDATE gained a Partnership Award in 1991.

Collaborative training and exchange programmes with overseas institutions are increasing educational opportunity and staff are actively involved in providing training and maintaining exciting links with the United States, Canada, Hong Kong and Europe.

A number of research activities include developments in resource-based learning and initiatives involving joint projects with industry and schools as well as product design and the patenting of inventions. All students are encouraged to undertake research which takes them into industrial contexts. Masters courses are pursued and the concept of competency-plus learning and total quality pervade all levels of student activity.

❑ Programmes of Study

CDATE offers Design and Technology subject modules that contribute to BA Modular Degree Awards in D & T, plus 2-year & 3- year ITT Awards. A full complement of D&T modules includes the following strands:

In the example here, the student, John Trumpeter chose to study electric point of sale technology:

❑ Electric Point of Sale

Project Outline

It is essential to understand the needs of the customer to ensure a successful business; their needs are paramount and therefore must be addressed. Research shows that shoppers consider the most important requirements of a supermarket to be friendly staff and speedy checkouts.

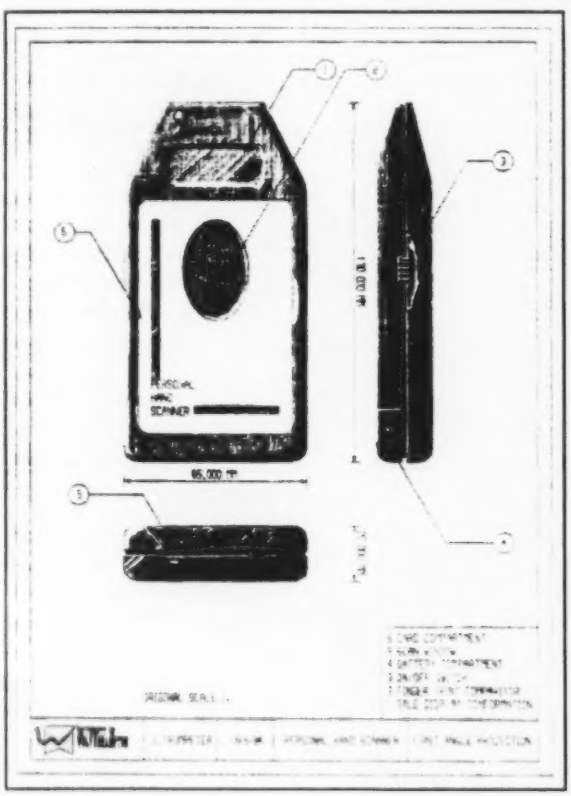
The use of debit and credit cards together with electronic fund transfer at point of sale (EFTPoS) is growing; this is quickly becoming the preferred method of payment in supermarkets.

EPoS (electronic point of sale) means that the goods you buy have bar codes and are scanned electronically at the checkout. The prices are stored on a computer and you are issued with an itemised receipt of what you have bought. EPoS is a modular system and each module can be customised if required to suit the exact needs of each retail organisation.

Most supermarkets now have EPoS and a growing number have EFTPoS. Money is deducted from your account as soon as your debit card is passed through a machine.

There are new developments in packaging, scanning, smart cards and computers, possibly the most exciting being the development of self-scanning equipment and intelligent packing which could reduce or eliminate the need for checkout staff. The members of staff freed from these tasks could then be made available on the shop floor to assist shoppers and offer a more personal service to the people that require it.

This project has provided the opportunity to produce a concept model of a hand-held personal scanning device which would automatically debit funds from an account when used in any situation.



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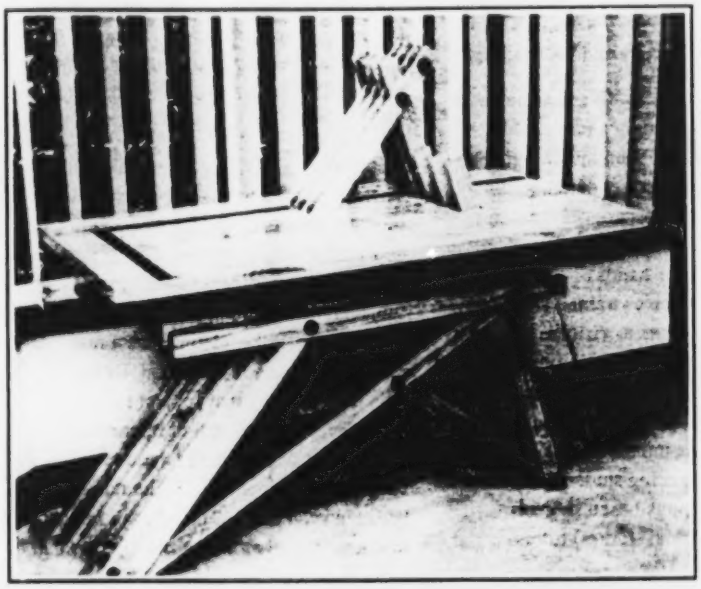
This project began with an exploration into the effects that can be achieved by contrasting various timbers and continued with an investigation into non-traditional methods of joining timber. It produced an unconventional method of framing for supporting a horizontal surface, thus enabling personal development in terms of materials and processes.



From the early experimentation a potential was identified to develop a final product around the contrast of ash and rosewood, and a method of constructing the frame using ash slats and exposed dowel joints was used. The major problem to be overcome was that of rigidity. Was the frame capable of supporting the top? The introduction of the cross braces appears to have overcome the rigidity problem.

The final outcome demonstrates the potential in terms of construction and illustrates the possibilities of transferring this construction method to other items of furniture. Although a writing table has been produced, it is satisfying that regardless of function, it is an item of visual impact and extremely satisfying to have had the opportunity to enhance my making skills.

— Graphic & Communication Presentation
— Designing & Making
— Technology
— Perspectives Business Issues

The following examples of students' work illustrate two contrasting modules in the Design & Make strand. The first illustrates a Critical Review module, which is described in the following terms:

> This module is concerned with a critical review and evaluation of a technological issue and its contribution to the development of the design and technology practitioner. Students are encouraged to articulate particular technology viewpoints to produce a mature body of scholarship and practice in a production context. Research will centre on the processes leading to innovation, product and manufacture.

The second example illustrates a student's work for the Personal Development module. For this module, Ruth Cleeton designed and made a writing table.

Bob Booth

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Technology Teacher Education: implementing Circular 9/92

Gerry Gregory and Bryan Nicholson

Dept of Education, Brunel University

DFE Circular 9/92 has willed the end of a strengthened partnership between HEIs and schools but has it willed the means of achieving it? This article reviews the current situation at Brunel University and considers the problems to be faced in school-based initial teacher education

Teacher Education at Runnymede

The education of teachers of technology has been going on at Runnymede since World War II: first within Coopers Hill Training College, then within Shoreditch College and since 1980, within Brunel University. Those years have been marked both by changes — subject identity, for example — and by continuity of an excellence that is recognised internationally.

Initial teacher education (ITE) at Runnymede has always been founded on a partnership between the higher education institution (HEI) and schools. Students have undertaken school experiences including (but not only) teaching practice and to an unusual extent they have found themselves in the hands of school colleagues who themselves trained at Runnymede and continue to visit the university for INSET, MEd. courses, exhibitions and conferences. In recent years a growing number of such school colleagues have become associate tutors of the university, taking on most of the role of tutoring students in school and liaising with campus-based subject-application (professional studies) tutors.

Circular 9/92

Circular 9/92 outlines procedures and criteria for secondary ITE. Of chief importance in the present context are two requirements. The first (school based) is that schools should take over responsibility for training students to teach and for initiating and delivering on their premises the bulk of the non-subject work that formerly took place at the HEI. The second (competence based) is that the preparation of teachers should rest on the development of professional competences: subject knowledge, subject application, class management, assessment and recording of pupils' progress, and further professional development. In respect of the Runnymede tradition, the first requirement is truly innovative, while the second is not.

Implications of Implementing the Circular

The first set of implications arises from the requirement for schools to take the lead in ITE, and successful implementation will depend on the extent of teachers' preparedness for new school-tutor roles. Preparedness here implies at least two things: a state of readiness (of having done the necessary preparation, and commanding sufficient resources of understanding, time, energy and support materials) and a sense of commitment.

It is the view of the Secretary of State that sufficient funding can be transferred from the HEIs to the schools to secure the latter's assumption of the leading role in ITE. Some (very few) schools are currently experimenting with such leadership roles with no recourse to any HEI. However, in the majority of cases the challenge seems to be to transfer sufficient funds without thereby causing the demise of the HEI.

A second implication concerns the relationship between general and (subject) specific school-based teacher education. Here the key notion is of subject application. If it can be assumed that student teachers know their subject (and in the case of postgraduate students this will sometimes be a reasonable assumption) then ITE will chiefly be concerned with how to teach that subject to pupils. However, there is much of importance to the student teacher that goes beyond subject, its extension and application. The relationships between such parts of the education of student teachers as well as between subject and general school tutors will need skilful management.

In addition to the 'school based' requirement, the technology specialism is, as so often, a special case. There are particular challenges in delivering school-based technology ITE (developing an unusually wide range of required skills, for example, or helping student teachers achieve safety certification), and these are especially acute in respect of PGCE students with diverse profiles of qualifications on entry.

First steps in implementation

The concurrent pursuit of degree subject study and teacher education has traditionally been considered valuable for the gradual, incremental progress it allowed in subject expertise and teacher competence. At Brunel we have adhered to the principle of student technology teachers working throughout their courses alongside industrial and product designers. This has been in spite of increasingly severe timetable problems in integrating the contributions of both education and subject departments, and has inevitably entailed compromises.

Circular 9/92 requires student teachers to be away from the HEI for much longer periods

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than before; hence, with its introduction, course-long concurrent study with design department students has become impossible. The decision to shift from a concurrent to a two plus two mode (i.e. two years of subject study followed by two years of teacher education) has been taken somewhat reluctantly for the reasons implied above and because it has meant the demise of the pioneering and popular three (extended) year BA programme. However, apart from the relief afforded to timetablers, gains are that the timing of teaching practice experiences within periods of school-based learning is now unconstrained, and that it should be possible to recruit into the second two (ITE) years students with HND qualifications or other appropriate prior learning.

A second Brunel response to 9/92 has been the delivery of (subject) training programmes for school tutors (mentors) — the first in July 1993. From this experience has arisen a number of implications of the implementation of Circular 9/92, discussed below.

■ Issues of Implementation

Aims

Early in our first training programme, school colleagues attending were asked to identify what they considered to be the aims of ITE in general, and of technology teacher education in particular, without reference to either Circular 9/2 or the statement of programme aims built into the Brunel courses. The importance of partners from schools and HEI negotiating common aims for teacher education scarcely needs stating. However, what emerged as an unintended by-product of this exercise was the close identity which emerged between the aims formulated collaboratively by school colleagues with those of the HEI:

> It was noted (1) that the purposes participants identified tended to emphasise generic preparation for teaching rather than a narrower, specific focus on preparation for teaching *technology*. Also that (2) there was strong correspondence with the purposes (expressed as course aims and objectives) of the Brunel initial technology teacher education programmes.[1]

As the school HEI partnership enters a new phase, discovery of this common vision is encouraging, especially for student teachers whose proper nurturing will depend on commonality of purpose within the partnership. Of further significance is that it tends to explode the myth that HEIs peddle various brands of irrelevant theory (often identified as of 1960s origin) whereas schools would take a no-nonsense, feet-on-the-ground, back to basics approach. There is no space here to take up the implied theory issues beyond noting that any approach to teaching and learning rests on one theory or another, and hence it is important to make that theory explicit so it can be interrogated; that, as Kurt Lewin once put it, there is nothing so practical as good theory[2] and that, to echo Barry Hugill's maxim, 'Spare the theory, spoil the teacher'.[3]

■ Competence-based teacher education

The implications of a competence-based approach to teacher education (CBTE) have been much examined in recent years, especially since the publication of Circular 9/92. Issues include:

- the meaning of 'competence'
- how competence relates to 'performance' and the knowledge, understanding and attitudes that underpin it
- how far general competence is merely (or more than) the sum of a number of particular competences
- the lack of relationship between different (e.g. person-related and task-related) types of competence
- the problem of generating an agreed list of competences for a profession that is part art, part craft, part professional activity and yes, part labour[4]
- the danger of CBTE encouraging an excessive emphasis on observable, measurable teacher skills and a correspondingly narrow view of what constitutes teacher competence
- the challenges in view of all the foregoing of appropriately assessing competence.[5]

In our recent experience, school colleagues have tended to stress that whilst competence in the workshop teaching of technology is a vital — indeed, the core part of the teacher's contribution — nevertheless there is a great deal more to being a teacher than this alone. The commonly expressed view is that teachers must be prepared to contribute to the running of the school generally; to take part in

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whatever form of pastoral system is in place; to interact effectively with parents[6], and to take part in professional development work in school and in professional debates in subject associations and beyond.

Given all this, and given also the indications that resources for in-service teacher education once provided by the majority of LEAs have been reduced as their powers have been stripped away, so ITE has increasingly to set teachers up for life! Hence, beyond short-term, instrumental emphases, helping student teachers develop sound understanding and defensible philosophies of teaching and learning (underpinned by an understanding of how children learn and an appreciation of the social context in which they do so) is ever more important. (There are already suggestions[7] that the greater emphasis (in an earlier wave of teacher education reform) on student teachers' own academic studies at the expense of study of child development is producing teachers whose understanding of the latter is so poor that they are unable to control children in the classroom.)

■ Schools taking the lead

There is scant evidence that this is happening in genuine partnership arrangements although there are cases where special funding is available, or where schools have urgent (e.g. falling roll) needs to broaden their portfolio of activity in a bid to secure their own position.

Our own consultations with subject heads of department show clearly that whilst they are willing to continue to co-operate with HEIs as they have done for many years, the prospect of them taking the lead is a chimera. As they struggle to bring themselves and their colleagues into line with every new challenge of the National Curriculum and its assessment, to cope with teacher appraisal, records of achievement and the implications of LMS or GMS, and to play their part in marketing their schools in increasingly cut-throat competition for pupils with all this, they simply do not have time. What schools are telling us is that it is *we* who must take the lead in providing the academic aspects of detailed planning, assignments and assessment arrangements; that the most we can expect from schools is that they will join with us in their mediation to student teachers. It is on this basis that we are having to develop our programmes to meet the criteria of Circular 9/2.

For all this to take place it is of course vital to assert the importance of partnership. Our training days have demonstrated this. The frustration of knowing that funding is unlikely to allow this on a regular basis is clear, but both school and HEI staff have pronounced the experience invaluable. Partnership had pre-dated Circular 9/92 at Brunel: for more than five years we had had a growing number of 'associate tutors' who not only acted as consultants but carried out duties in their own schools which reduced to a minimum the need for visits by HEI tutors.

The duties of the school co-ordinating tutors involve:

— liaising with the HEI on a regular basis

— liaising between subject and general school tutors in setting up suitable timetables for students and monitoring progress

— arranging for groups of students to be able to carry out school-based learning: that is, *in school* to investigate, shadow, observe and otherwise learn about their subject and its application, and about education generally what, traditionally, they would have learned on campus

— expending time and effort on tutorial help, lesson observation and assessment.

One estimate is that this will need to involve at least an hour per week per student, and the sums suggest that the cost of more time devoted to the job would have to be covered by the schools own budget. In our PGCE distance-learning course arrangements, schools are contracted to provide half a day per week, or equivalent. Just how demanding the job is if done properly may be inferred from the decision of Harrow School to withdraw from the London Institute of Education scheme and the warning from the Institute's director that several schools are expressing similar reservations.[8]

■ The relationship between general and subject-specific mentoring

In this respect technology — like science — represents a special case. Arguably, the classroom-based subjects, whilst having their own teaching and learning characteristics, nevertheless share a good deal in terms of class management and teaching technique. Some of this carries over into workshop teaching, but

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much does not. The workshop, when expertly run, can offer a less formal learning environment while remaining under firm control. Informality must be firmly distinguished from licence.

HEI tutors (whether or not they are technology specialists), with long experience of visiting school workshops will be well aware of various workshop management styles, pitfalls and opportunities. Given its open-endedness, there are particular issues — those concerning structure and differentiation, for example — that are peculiar to technology teaching. Not all visiting tutors from other curriculum specialisms will understand this; nor will all *school* tutors with only classroom (as opposed to workshop) experience. Hence there is a need for student teachers to be visited by specialists as well as by generalists: to establish what is (or is not) going on, and to decide what needs to happen. For a student to be given confusing — or worse, contradictory — advice will be unacceptable. Similarly, specialist input will be essential to the proper assessment of students.

Clearly, there are aspects of the formation of a professional teacher that are in no way subject specific. Teachers will need understanding of the pastoral system in schools; they will normally be expected to involve themselves from Day 1 of their salaried career in this work. Furthermore, given the integration of many children with special educational needs into mainstream classes, there will be a need for considerable understanding in respect of them. Any serving teacher could add a dozen further examples.

It is in such important work that generalist mentors will play a key role. They will often be people who, through training and experience, will be the right persons to offer guidance, information and support. However, none of the foregoing is meant to suggest that there can be a neat division of labour. Matters like student teachers' class discipline will need to conform

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with school policies and there will be issues where absolute consistency is needed — be they related to playground, classroom or workshop.

The training needs of school tutors

HEIs (the awarding bodies) need to be confident that selected school tutors are effective teachers with experience of school management — if not as heads of department or faculty, then at least in the context of responsibility for work beyond their own teaching. Appropriate personal qualities and skill in working with adult learners will be similarly essential. Thorough familiarity with the prevailing National Curriculum Technology, experience with existing and new GCSE syllabuses (and in some cases, with A level, A/S level and GNVQ) — all these will be important. Furthermore, school tutors will need to have mastered the processes of assessing NC Technology as these are proscribed at any particular time. Finally, the school tutor must be no stranger to the issues of Information Technology — at least as these pertain to NC Technology.

As if this were not enough, those venturing into teacher education need to be not only effective practitioners in their own right, but also to have analysed the nature of classroom and workshop practices. They need to know why they do the things they do and how to make that understanding available to student teachers. They need to be able to predict what would happen, for instance in terms of classroom management, if alternative courses of action were adopted. They need understanding of how far pupils' learning experiences need to be structured or left open and how mixed-ability challenges may be met in the potentially hazardous workshop environment.

At Brunel, we recognised the need to involve school tutors in two full days of discussion, emphasising that this was two-way traffic. However, it was equally clear that the job had been started rather than completed: further visits will be needed to develop the dialogue, and there is a need for further, extended sessions on campus. Much can be accomplished through high-quality paperwork, drafted and redrafted in the light of continuing professional dialogue.

Transfer of funding

The viability of education departments to continue ITE work represents a considerable challenge. On the one hand, the extent to which any education department can earn its living through in-service training for teachers and offering higher degree programmes is increasingly limited in these times of dwindling resources. On the other, the cash available for distribution among contributing schools is simply insufficient for the job to be economically attractive to schools.

The placement of students

The development sessions at Brunel indicated that about an hour a week of school tutor time would be released per student, and whilst this would be feasible if a critical mass of students were to be gathered together, it would be insufficient in a given subject area.

At the time of writing, we at Brunel have recently completed a marathon telephoning operation. Three hundred calls requesting school places have been made on behalf of 150 student technology teachers (undergraduates and postgraduates), all of whom must now spend longer in schools. Fortunately, most schools are still willing to help, though chiefly in traditional rather than 9/92 ways.

A major concern of HEIs is the possibility that too few schools will agree to provide 9/92 places for all students already on course. For those institutions operating two plus two courses and thus thinking forward to autumn 1996 this is something of a time-bomb. It is difficult, to say the least, to be sure of the policy and circumstances and even the secure existence of schools two years ahead, and this presents dilemmas in terms of recruiting.

Achieving a cost-effective mass of students

Althought the issue of student-staff ratio is central to school-based ITE, it appears to have been largely overlooked in the drafting of 9/92. HEI tutors teach 1520 students in workshops, perhaps 2040 in seminars and sometimes over 100 in lecture rooms. It is difficult to imagine any responsible school management team or governing body accepting into their schools groups of our students of this size *in a particular subject*. On the other hand, there are general topics that can be handled in schools with larger groups of students drawn from different subject specialisms, with considerable

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profit accruing from the different subject perspectives of such students.

■ 'Clustering'

It would clearly be highly desirable to cluster teacher practice schools, so that on occasions students could be collected together in a particular school to receive subject-specific information and training. However, there will be logistic challenges here. There will be the problem of what the students are missing while they are away from the school on such occasions, and there will be travel difficulties where students lack their own transport. At Brunel, for the moment we have agreed to circulate to all technology experience schools details of where *all* our students are in schools. Teachers have agreed to explore what might be feasible for clustering. It would, however, be more logical to have them back on campus where all this could be done more efficiently, with staff and equipment developed over many years for just such a purpose.

■ Accreditation

In the foreseeable future, HEIs will continue to be responsible for the quality of the teaching and learning in ITE programmes, in partnership with schools. However, it will be the reputations of the HEIs that are tied to the validation of the eventual qualification. Within a university, this is not a matter for any one department alone. Universities work through corporate management: joint responsibility is vested in senates, degrees committees and faculty boards, and external examiners of experience and academic authority are appointed to check quality through a sampling process. As teacher education work becomes more decentralised, this will become increasingly complicated, necessarily involving more and more visits by experts from various centres to collaborate with experts in schools in order to arrive at workable forms of quality assurance. Such travelling and visits are expensive.

■ Travel and accommodation

Many student teachers need accommodation on the university campus in order to follow their courses. Where an HEI is located in a major conurbation such as London, with good public transport, it will often be feasible not to offer living accommodation and to require students to use public transport to get to schools. However, away from the conurbations it is less

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simple. All HEIs are short of residential accommodation as a result of central government pressure to get more students into higher education. It is at least imaginable that the senior management of HEIs will decide to give low priority to students who are on campus for but a small proportion of their time, and where most of the cash to teach them is diverted elsewhere.

HEIs have the responsibility to meet at least some of the students' travel costs for school experience, whether public or private transport is used. As student numbers increase, the area over which students are spread enlarges and inevitably, transport costs grow. Furthermore, as students spend more time in schools, transport costs increase in proportion. In fact, the sums will come to more than the total money available. The situation is fast approaching where it may be more sensible for students to live near their current school-experience schools, and travel to the HEIs instead.

Technology skills training

Whilst all PGCE technology students recruited by Brunel have valuable aspects of technology in their background, very few indeed have a first degree which gives them the *whole* of the subject range represented even by CDT, together with the required IT elements. It is vital, as the students insist each year, to augment their subject knowledge by filling the gaps. Given that there is statutory safety training for workshop teachers, the time students may remain on campus is quickly used up.

Loss of industrial placements

When the fundamental design of the current undergraduate courses was settled in 1980, education tutors were generally sceptical of the value of industrial placements in such courses, arguing that school experience was the appropriate kind of industrial placement for intending teachers and should count as meeting the absolute sandwich requirement of all Brunel's undergraduate courses at that time. However, the placement programme has been popular with student teachers and their subsequent employers and has brought a greater awareness of the world of industry into student teachers' technology teaching, into their reflective essays on education topics and, sometimes through sponsorship, into their (sometimes award-winning) major project work. It is to be particularly regretted that under 9/92, industrial placements will no longer be feasible in our BSc programmes.

Conclusion

Circular 9/92 has willed the *ends* of strengthened HEI school partnership and improved standards in ITE and of greater precision in gauging student-teachers' competences. However, in leaving it optional for schools to participate in the provision of far more school-based learning than heretofore, and in leaving HEIs with reduced power yet undiminished responsibility for the achievement of improved competence among beginning teachers, the circular has scarcely willed the *means*.

Concern about the policy expressed in Circular 9/92 which inaugurates practices of undemonstrated and unresearched effectiveness has been voiced by a succession of professional organisations and by many teachers, as we know from contact with our partner schools. A trawl of the growing 9/92 literature suggests that HEI colleagues tend to be less than enthusiastic about the prospects for implementing 9/92. Even some who at the outset expressed enthusiasm for the new approach to teacher education appear now to have modified their views. For their part, some schools have voiced the fear that their contributions will not be sufficiently recognised. They fear that HEIs will have merely to use them and will be unable to provide the necessary level of support.

Whether 9/92 will prove minimally feasible i.e. whether sufficient school-based weeks will be made available for all the student teachers who must have them (leaving aside the question of the *quality* of the experience) is at present a matter of uncertainty. OFSTED's work in monitoring the quality of ITE under the new arrangements will be vital, and it is not inconceivable that a Dearing-type review will be needed, sooner rather than later.

What is not in doubt, however, is the determination of HEI and school colleagues to make the system work as well as possible for those who offer themselves for training and whose quality has so impressed us in the current round of recruitment. The long technology teacher education tradition associated with Runnymede and the generations of teachers and their pupils who have benefited from it demand no less.

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Values in Design and Technology: an Anti-Racism Dimension

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David Layton's paper on Values and Design and Technology provides an account of the principal agents that have been involved in the socio-political shaping of school technology.[1] In addition to the economic functionalist, professional technologist, women, sustainable developer and liberal educationalist stakeholders that he identifies, this paper seeks to contribute towards the further introduction of a sixth force, one informed by an anti-racism perspective.

The 1988 Education Reform Act[2] requires schools in England and Wales to provide:

> . . . a balanced and broadly based curriculum which:
>
> (a) promotes the spiritual, moral, cultural, mental and physical development of pupils at the school and of society; and
>
> (b) prepares such pupils for the opportunities, responsibilities and experiences of adult life.

The National Curriculum Council (NCC) curriculum guidance[3] suggests that all teachers should therefore accept the responsibility of providing an education for life in a multicultural society. This cross-curriculum dimension, it is argued, is to permeate the whole curriculum and is intended to:

- extend pupils' knowledge and understanding of different cultures, languages and faiths
- value cultural diversity by drawing on pupils' backgrounds and experiences
- offer positive images and role models from all cultures. (NCC, 1992)

As the NCC publication *Curriculum Guidance 3: The Whole Curriculum* (1990) states:

> . . . introducing multicultural perspectives into the curriculum is a way of enriching the education of all our pupils. It gives pupils the opportunity to view the world from different standpoints, helping them to question prejudice and develop open-mindedness.

This paper provides a critical review of the guidance currently on offer to those teachers of technology who wish to implement these aspects of the National Curriculum. While many of the arguments contained may be considered relevant to gender and other technologically marginalised groups, and to other countries, in the interests of clarity this paper restricts its concern to the issue of values in technology education as they relate to the provision of racial equality in the UK.

Equality and Underachievement

As John Eggleston has suggested[4] there is an urgent need to address the problem of the underachievement of black pupils in design & technology classes: ethnic disadvantage in access to examination classes and examination success seems, in many if not most schools, to be just as marked in Design and Technology as it does in the others. Eggleston argues that, before we can solve this problem we need to understand the sources of the powerful social pressures that have, for generations, differentiated technological achievement by race (and gender). In reviewing the evidence, Eggleston points to the tragic consequences of stereotyping and the unintentional racism of teachers who do not challenge the popular assumptions surrounding the motivation, behaviour, language ability and cultures of their black pupils.

According to Eggleston, this process is likely to be further exacerbated in design and technology classes where teachers are anxious to recruit pupils considered academic and of high status to their newly enhanced high status courses. Eggleston points to the need for schools to inform and work closely with parents in improving access to courses and in exploiting the opportunities for multi-cultural technology education inherent in the National Curriculum Technology Orders. Eggleston cites the ASE publication *Race, Equality and Science Teaching: an active INSET manual for teachers and educators,*[5] as a valuable resource, and the ASE sister volume, *Race, Equality and Science Teaching: a Teachers' Handbook*[6] has now also been published offering more useful guidance.

Much of the writing on racial equality in science education offers a valuable source for the understanding of issues associated with access and achievement, teacher expectations and attitudes, pupil encouragement and self-image, racial prejudice and discrimination (Rattansi[7] for example, and Siraj-Blatchford[6] and Reiss[8]). Such concerns, and strategies such as the provision of positive role models and relevant non-stereotypical curriculum experiences, clearly apply equally to design & technology.

Unfortunately, the growing literature on anti-racism and science education has yet to be followed by an equivalent treatment of the issues in design & technology. While writing on gender issues predate the Girls into Science and Technology (GIST) Project (1980-84) racial equality remains relatively neglected. The treatment of the subject is also, thus far, restricted to a narrow concern with the underachievement of black pupils in

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Notes

1. This is an edited version of a paper first presented at the International Conference on Design and Technology Educational Research and Development (IDATER 93) at Loughborough University of Technology.
2. The term black is used advisedly to refer to those sharing a common experience of racism; in the UK these groups are most commonly of African-Caribbean or South Asian origin. The term is thus a political category commonly used in the UK race relations field.

technology itself, and has failed to respond to the challenge of the 1988 Education Act to apply racial equality across the curriculum.

Values

David Layton[1,9] has argued that the consideration of values should be central to education in design & technology. He provides a clear account of the key strategies that have been, and continue to be, employed to resolve value conflicts in technology, and as he argues, value conflicts often result in winners and losers, and technologies are often *imposed*. It must be remembered that the technology curriculum is as much defined by the exclusion as by the inclusion of content. In choosing *not* to consider certain aspects of the subject we are taking political and moral decisions that will influence our pupils understanding of the subject and of their role within it. As Layton[1] argues:

> The politics of technological literacy — who creates and controls the meanings of the phrase, how the imposition of meaning is achieved — is a central concern of technology education today and is inescapably rooted in value considerations.

He also recommends the use of four perspectives that teachers may apply to bring values into prominence, which involve the recognition that:

1) technologies are successful when the values embedded in the design are congruent with the dominant social values of the consumer culture
2) conversely, technologies become obsolete when the values that are embedded in them are no longer congruent with society
3) technologies transferred between cultures often result in the rejection/radical adaptation of the technology or else the often damaging transformation of the society
4) for all of the above reasons we must be aware of the distinctly gendered moral orientations of men and women, boys and girls.

Layton usefully cites the work of Goonatilake[10] and David Nobel[11] and argues that 'There is nothing inevitable about the form which a technology takes; it is shaped by the value decisions of those in control'. He also suggests that the National Curriculum opens the way for critical reflection not only on all aspects of pupils' own work but also on the value options and decision processes which have empowered technological developments in the past and which are doing so today.

Layton argues that there is a need to make values the subject of deliberation and critical reflection between pupils and between pupils and teachers. One might add that there is still an urgent need to encourage this process between all of those involved in the development of technology education.

Technological Racism

Technology education represents more than just another valid sphere for anti-racist practice. Technology lessons provide more than merely another context in which black and ethnic minority students are disadvantaged. Our treatment of science and technology in schools and in the wider media has provided a major, if not *the* major support to racist ideologies. Racism occurs when the application of prejudiced (albeit often unconscious or unintentional) attitudes lead to discriminatory actions. Many, if not most of our white population, still believe themselves to be culturally superior to black people. Our pupils' common sense (yet totally mistaken) everyday observations confirm their prejudices: they see relative poverty and infer inferiority, and it is the basis of these fundamental prejudices that need to be challenged.

These are not the overt racist attitudes cited by Eggleston (the teacher who tells the boys to get down off the banana trees to continue their work or the girls to cover their grass skirts). These are the sort of attitudes reflected in Gordon Taylor's *Salute to British Genius*[12] where he writes:

> The British are a remarkable people. In proportion to our population we have arguably contributed more to the advance of the world than any nation since the Greeks — and in the modern world our contribution is absolutely greater. This is a fact which we are in danger of forgetting. A generation is growing up which has little knowledge or appreciation of its extraordinary history. This is tragic, for a sense of history is the foundation of culture.

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Clearly the culture envisaged by Taylor is a mono- rather than a multi-cultural one, although Taylor's concern does have a more global dimension, as he goes on to argue:

> Foreigners, too, frequently have a distorted picture. It is not only that they think of England as a land of fogs and are amazed when the sun shines; often they think of us as a nation which has grabbed, a ruthless imperialist power, and know little of what we have given to the world.

It is perhaps significant that the very first example provided by Taylor in this celebration of British Genius is the electric light bulb:

> . . . the year 1877 was a particularly productive and interesting one . . . Joseph Swann, with his assistant C. H. Stearn, renewed his long abandoned efforts to produce a practical electric light bulb: he succeeded within a year, thus launching electric lighting as we know it, and thereby the whole electricity industry.

While some may be puzzled, having read other accounts of this invention that attribute the development of the electric lamp to the American Thomas Edison in 1879, it is instructive to note that the first person to actually obtain a patent for a practical lamp (that is with a filament held by supports in an evacuated bulb), that made electric lighting a really practical alternative to gas, was Lewis Latimer, and that was in 1881. Latimer was an Afro-american, the son of a runaway slave. He fought in the Union Navy during the civil war and produced his system for mounting filaments in evacuated bulbs while he was working for Maxim, the inventor of the machine gun. Amongst many other projects undertaken, Latimer came to Britain and supervised the manufacture of carbons and the installation of lighting in London in the late 1870s.[13]

Contemporary historians are familiar with such whiggish accounts of history, written to justify particular societies and social groups, as such accounts have been common in the past. In case we should be in any way doubtful regarding the composition of the British society that Taylor is celebrating, he offers character portraits of the ethnically diverse groups that he considers make up the British Isles:

> . . . the proud, intelligent, religious and unfathomable Scots. . . the minute, musical, clever and temperamental Welsh . . .the charming, untruthful, bloodthirsty and unreliable Irish . . . and the unintellectual, restricted, stubborn, steady, pragmatic, silent and reliable English.

My point here is not one restricted to Taylor, although his lack of inhibition for stereotyping may seem startling; my point is that he reflects the popular views of the times. These views are reflected and reproduced in the pages of the popular press and are voiced routinely in conversations throughout our society. Teachers are not immune to such ideas although the degree to which they are expressed in an educational environment that is increasingly, if very gradually, expressing a commitment to achieving racial equality is certain to be reduced.

While the implications of such views to the future development of our society and to the educational futures of our black pupils may be devastating, their expression is often muted in subtle terms. It is important to recognise that such terms as 'the third world', 'developing countries' and 'intermediate/appropriate technology' are all value loaded, they all suggest patronage and a comparative cultural deficit, and more seriously perhaps they all reinforce false notions of a first/third world linear continuum of cultural sophistication. They offer a distraction from the real causes of poverty in the world as well as to the significance of what Salman Rushdie termed 'the empire we have brought within' our own society.

■ Appropriate Technology

The logic and concerns of Appropriate technology[14] found their way into the National Curriculum Design and Technology orders where pupils have been required to:

- know that in the past and in other cultures people have used design and technology to solve familiar problems in different ways (AT1, 14f)
- recognise that economic, social, environmental and technological considerations and the preferences of users are important in developing opportunities (AT1, 15f)
- explain how different cultures have influenced design and technology,

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both in the needs met and opportunities identified (AT1, l6b)

- investigate how needs and opportunities have led to design and technological activity in other cultures (AT1, l8c)
- understand the social and economic implications of some artifacts, systems or environments (AT4, l4c)
- illustrate the economic, moral, social and environmental consequences of design and technological innovations including some from the past and other cultures, using specific examples (AT4, l6e)
- understand that artifacts, systems or environments reflect the circumstances and values of particular cultures and communities (AT4, l8b)

In a sense, technological achievement is always appropriate to the society in which it occurs. Social needs and desires, along with the resources that we are willing or able to release to satisfy them, determine the technology that we develop. Some might even argue morbidly that western societies deserve the alienating and ultimately unsustainable technologies that we have developed for ourselves, given our greed and hedonism. But what is important here is that technology is always appropriate in this sense in other societies and has been appropriate at other times. From this black perspective relative poverty and power become the major criteria of difference between cultures rather than relative development. Poverty and its causes, in terms of unequal trade relations and debt re-servicing becomes a more obvious choice for study than the sort of appropriate technology transfer promoted in the educational materials produced by charities such as the Intermediate Technology Development Group. Despite some excellent work that has been carried out by dedicated teachers under the appropriate technology umbrella, it needs to be recognised that this perspective is inherently patronising and inadequate on its own in the face of racist ideology.

Other technology attainment targets refer to the need to seek new ideas in other cultures (AT2, l3c), and to evaluate technology from other cultures (AT4, l2b/5c). These attainment targets have offered vital space for promoting anti-racist education in their own right and despite reassurances that the underpinning conceptual framework of the Technology Order will be preserved[15] every effort needs to be made to protect this space in the application of the revised Order.

Conclusions

As Layton has argued, the aim of liberal educators is to initiate children into the symbolic world of technology, to assimilate them into an epistemology, a theoretically defined form of knowledge. What I am arguing here is that the epistemology that is often promoted and presented is defined in essentially liberal ethnocentric terms. Liberal educators aim to introduce pupils into, to adopt Thomas Kuhn's term, a normal subject paradigm. Neither the demands of 'constraints in working contexts' and/or of 'functional design should be taken uncritically as offering the definitive foundations of our subject. An adequate technology education should be one capable of continued reflective critical evaluation.

Our technology education needs to be in a permanent revolutionary mode, accepted as both shaping and being shaped by society. As Layton suggests, the explicit recognition of different value positions and the attempt to achieve compromise or consensus may not always be successful, particularly where one is dealing with conflicts between short-term immediate survival perspectives and longer term future needs. But as he says at very least: 'What might emerge from such value confrontations is . . . the re-prioritising of values in the positions of individuals and groups and also the reorientation of research efforts to achieve technological and design solutions to the conflict'.

As Glenda Prime[16] has argued, technology education has an important role to play in the development of pupils' cognitive and affective skills: 'Technology education must aim to produce technological awareness, so that citizens are made sensitive to the social and cultural implications of technology'. The social dangers inherent in the blind adoption of the latest technological developments lie, as Prime says, not in the new powers that these technologies provide themselves, but in 'the subordination of the new powers to old values like greed and exploitation'.

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Book Reviews

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SCSST, £25.21 + VAT

Reviewed by Chris Snell

It is refreshing to receive a usable package for electronics that actually gives pupils a good working experience of the subject. This package consists of a resource book of support and activity sheets, all freely photocopiable, case studies and a 15-minute video. The support sheet format prompts a consideration of the topic (Symbols and Circuits to Sensors and Warning Systems) and component area (batteries, bulbs and switches to 741 Op amps). While the pack will be of great use to KS2 teachers who have had little training in electronics, it still retains rigour demanded by KS3 &4. Useful practical tips for complete novices are given without sacrificing credibility; simple multi-switch bulb circuits introduce the concept of truth tables to be introduced painlessly, for example, with any reader being barely aware of its introduction and development.

The material is also beneficial in that it warns of the consequences of mistakes rather than merely describing a perfect system. In circuits using a more diverse range of components, apparent malfunctions and their cure are also covered: 555 chips can inject 'glitches' (voltage spikes) into supply lines, for example, undetectable without specialised equipment. These glitches can cause erratic behaviour in other chips in the same circuit; the cure is to 'decouple' the 555 with 100nF and 10nF capacitors, and all circuits using 555 chips show how this is done.

The case studies have been carefully chosen and written with an economy of style. As exemplary material it provides even the most unimaginative teacher with ideas for further development and a basic feel for what could be accomplished by a sufficiently inspired pupil of even very modest ability. Extension ideas challenge the lateral thinking of 'high flyers', encouraging them to explore further. Finally, the video provides a useful focus for the whole package.

Taken overall, this is a useful, self-contained practical supplement to a D&T course that will stand with or without a complementary course treating the more numerate aspects of electronics. I would recommend it to all KS2, 3 &4 teachers.

MATERIALS: A DATABASE

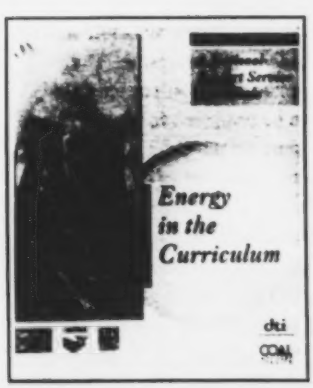
SCSST, £16.50

Reviewed by Bill Goddard

This package for KS2, 3 & 4 consists of a computer database and text for teachers and pupils. The database provides a wide range of information on a variety of materials and also enables them to be identified by keying in their properties.

The ten-page text describes the detailed categories of the database and an indication of the range of useful data-handling operations which pupils could carry out. For teachers it gives advice and ideas on using the database, on getting started, and on adding and selecting data, and examples are given relating the use of the database for design and make tasks as well as for science activities.

The database processes are clearly laid out in the text and two exemplar design and make tasks indicate how it can be used in support of each activity. For example, pupils could be given the task of researching the full database for materials most suitable for use in the school workshop. They can search records for different types and the suitability of materials



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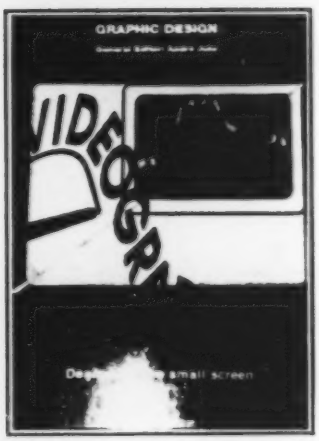
and look for more detailed analyses of materials properties. Commonly available forms, finishes, uses, cutting, shaping and joining methods can also be found on the database.

Fifty-two materials are available on the database and it is possible to add information to the records. It is also possible to reduce the quantity of data available so that excessive information is not provided. Although the text could be more helpful in providing system requirement information for using the database, this is a useful resource for teachers to use to enable pupils to have access to suitable information and could be a valuable addition to a technology resource base.

THE INVENTION KIT
Dorling Kindersley, £50
Reviewed by Faith Graham

The kit consists of the Inventions book from the well known 'Eyewitness Guides' series plus a teacher's book, set of project planner cards, help cards, wallchart and poster. The package is offered as a resource for integrated and cross-curricular learning for the 9-14 age group. I found it well presented and full of interesting, clear and colourful illustrations. The section on using the teacher's book is complex and detailed, although it contains little coverage of the Programmes of Study.



The linear process of think, plan, do and think again is promoted as the key means of working through the pack. Assessment and evaluation are viewed as 'key elements in beginning and completing any project or learning task' and inform the planning of future learning. Whilst making the link between assessment and future learning is commendable, the association of evaluation with completing an activity is misleading. The building and testing a model Help card details the learning process, what you will need to make the model and how to make and test it. Improvements to the model are decided upon through discussion and not treated as a first idea which needs pupils to go through the learning process again in a similar way as pupils would with the design process. The recommendations sound very prescriptive and do not enable pupils to realise their own design modifications or gain an understanding of the properties of materials in order to select appropriate ones for their task.

The package works as a vehicle for integrated and cross-curricular learning but is limited in its contribution to the whole curriculum. It is a very useful resource with the current National Curriculum and will be particularly helpful with the new orders for D&T as indicated in the latest draft proposals.

WORLD REVIEW OF TEXTILE DESIGN
The Textile Institute, £15
Reviewed by Ms W. Taylor

The Textile Institute, along with International Textiles, have produced the third issue of the World Review of Textile Design. It reviews the past and present and looks to future developments in textile design. This is a very exciting issue to read and particularly useful for KS4 students, but sixth-form students too will find it immensely useful. It should be placed in every sixth-form library.

THE THERMAL-INSULATION PROPERTIES OF FABRICS
J.O. Ukponmwan
The Textile Institute, £15
Reviewed by Ms W. Taylor

This is well worth reading for textile technology teachers. The Textile Institute produces research and developments in textiles which can prove useful at KS3 & 4. The book takes the reader through the complexities of thermal insulation in a very clear and precise manner. The experiments and tests could easily be carried out at Key Stages 3 & 4.

VIDEOGRAPHICS
Hugh Skinner
Batsford: £17.99 ISBN: 0 71347 401 7
Reviewed by Ian Wilford

This book came as a complete revelation compared with the normal run of books reviewed in this section. The subject so aptly covered is graphic design in the computer age, emphasising the opportunities available for the young computer-literate amongst us. The accent of the book is on the still or animated graphics that can be produced for the computer screen or television. As the book so rightly points out, this is an art form in its own right and it suggests to the computer-literate designer how those with an imaginative, flexible approach can be offered marvellous opportunities in the future. Video graphics is only just beginning.

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The book uses fifteen projects as illustrations of what is possible through this medium; some are in text, most in graphics and the book is about ideas, to be read and enjoyed. Simple yet effective limitations are described and used to great effect: text should be short and snappy, for example, and limited to six words per line and six lines per slide. Such rules should be avoided at one's peril. Another is never to leave the user with nothing happening: use messages such as *Please wait a moment* instead.

The book clearly outlines the art of videographics and the journey through it, of which many of us are still unaware.

PRODUCT DEVELOPMENT AND DESIGN PRACTICE
UIAH:
$40 ISBN: 9 51938 432 4
Reviewed by Dr John Hill

This expensive little volume (72 pages and soft covers) is one of three books in the series *Design Management —a key to success*, compiled from lectures given at the MGMT conference held in 1989.

Product development can be divided into two parts: firstly specifying what will be developed and secondly, product realisation. Seven of the book's nine sections are case studies illustrating the central importance of the design specification phase and include Bahco hand tools, Nokia mobile phones, Martela office furniture and the Philishave rotary shaver. In such a short volume, the case studies certainly whet the appetite and leave you wanting to know more.

The first chapter is the most interesting, dividing product design specification into two phases: the longer exploratory product research phase during which creativity is encouraged, and the rapid product development phase during which it is forbidden, and then lists the elements and tasks for each phase. The final section calls for an increased use of computers and CAD by industrial designers.

Summing up, this is an interesting collection of short articles which leaves you wanting to know more, but too expensive to recommend for purchase by schools.

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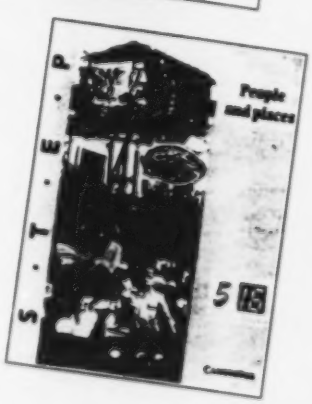

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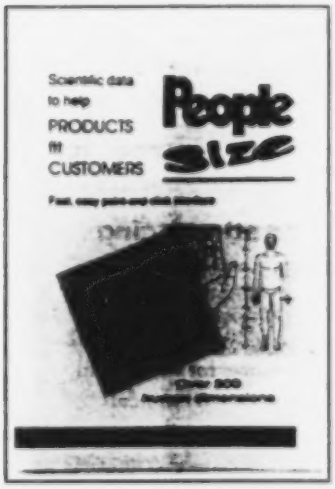
Software Reviews

PEOPLE SIZE — HUMAN DATA SOFTWARE

Friendly Systems Ltd, £149
Hardware: IBM compatibles
Reviewed by John Hanson

This program fooled me, mainly because the packaging and manual were so attractive that I dived straight in without reading the instructions properly. When I failed to install it (the instructions were on page 5 but I hadn't got that far), a phone call to the publisher produced some excellent support. It also fooled me because I thought it was another anthropometric program that would allow my pupils to print out some deformed representation of human beings. It turned out to be much more valuable: a large database of human dimension measurements laid out in a very interesting and attractive way. Because the program runs in Windows 3.1 the graphics are good and the menus laid out in a clear and usable way.

The handbook is mainly about installation, but the extensive on-line help facility and the program's simplicity make it very easy to use. I enjoyed experimenting and could find a lot of uses for anyone concerned with design. It should cause potential designers to think about the statistical range of human measurements and provide them with a useful tool. It is an excellent piece of software that could find many uses in technology teaching and could help the development of ergonomics and anthropometry in the technology curriculum, but it is expensive so thought would be needed before purchase. Friendly Systems might find that more schools would be able to make use of their friendship if the software was priced under £100.



CORTEX — THE PERSONAL EXPERT SYSTEM

Resolution Software, £35 (£5 for 30-day evaluation)
Hardware: IBM compatibles
Reviewed by John Hanson

This program is an expert system shell which allows you to create your own expert system file for anyone (yourself included) to use. It is a good, well written, text-based program which went easily onto the computer and worked immediately. I received a 50-page, densely written manual with my disc, containing good explanations of installation, running and creating data files and the concept of an expert system. I like the idea of sending out a manual with a limited duration disc because you have all the information necessary to understand the program.

This is a very good illustration of an expert system at a very reasonable price and anyone who wishes to illustrate expert systems in a school or college would find it useful.

My problem with software like this, however, is why would anyone want to use it? My understanding is that these systems pool a greater amount of knowledge than a single individual can bring to a problem, perform consistently and allow inexperienced users to deploy knowledge and expertise in a subject. If this is the case then 'Personal expert system' is a contradiction in terms. Expert systems should also be self-learning and extend themselves by use, but this program requires the implementer to add alterations and amendments to the datafiles. This means that the users — particularly many of the teenage cyberpunks that I teach — will find that the expert system is wrong, and this will not impress them.

If you want to illustrate Expert Systems this is a good, simple and cheap way of doing it, but be careful of the messages you are giving out. Your pupils may come away with the false idea that reality is a lot less interesting than fantasy. I would be much more impressed if the author could supply a lot more datafiles on interesting topics, new to most pupils, and arrange for the program to learn from its mistakes.

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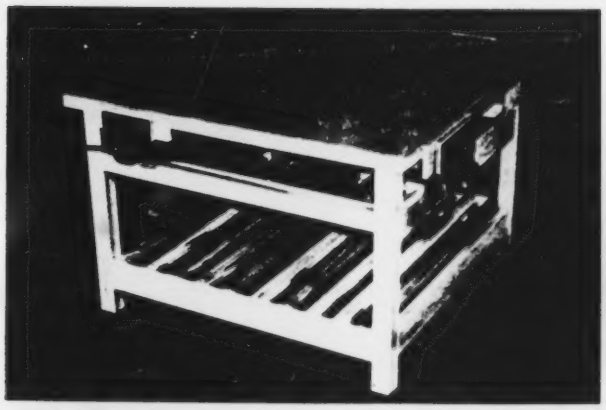

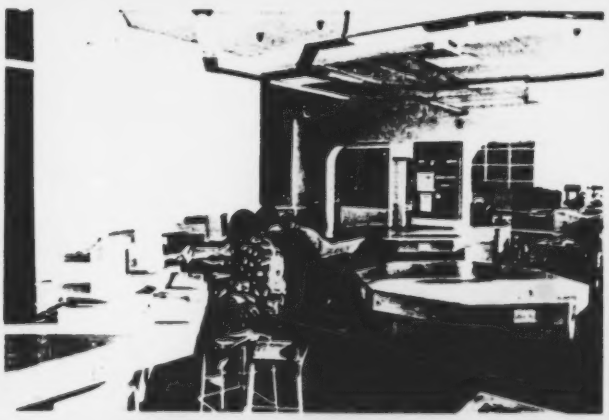
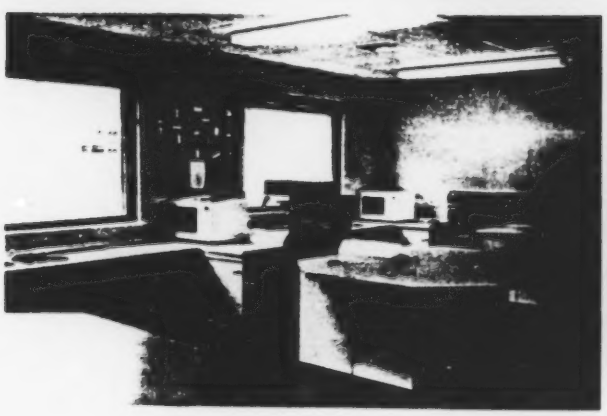
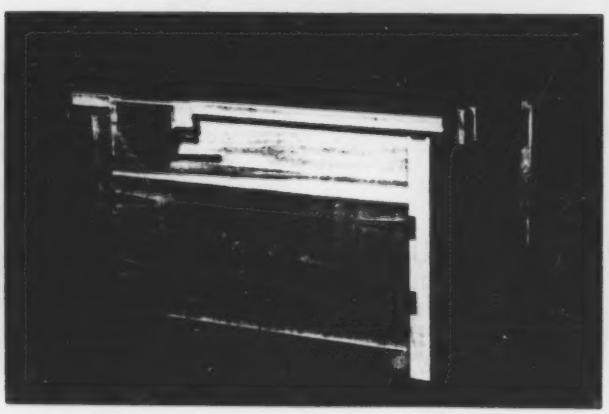

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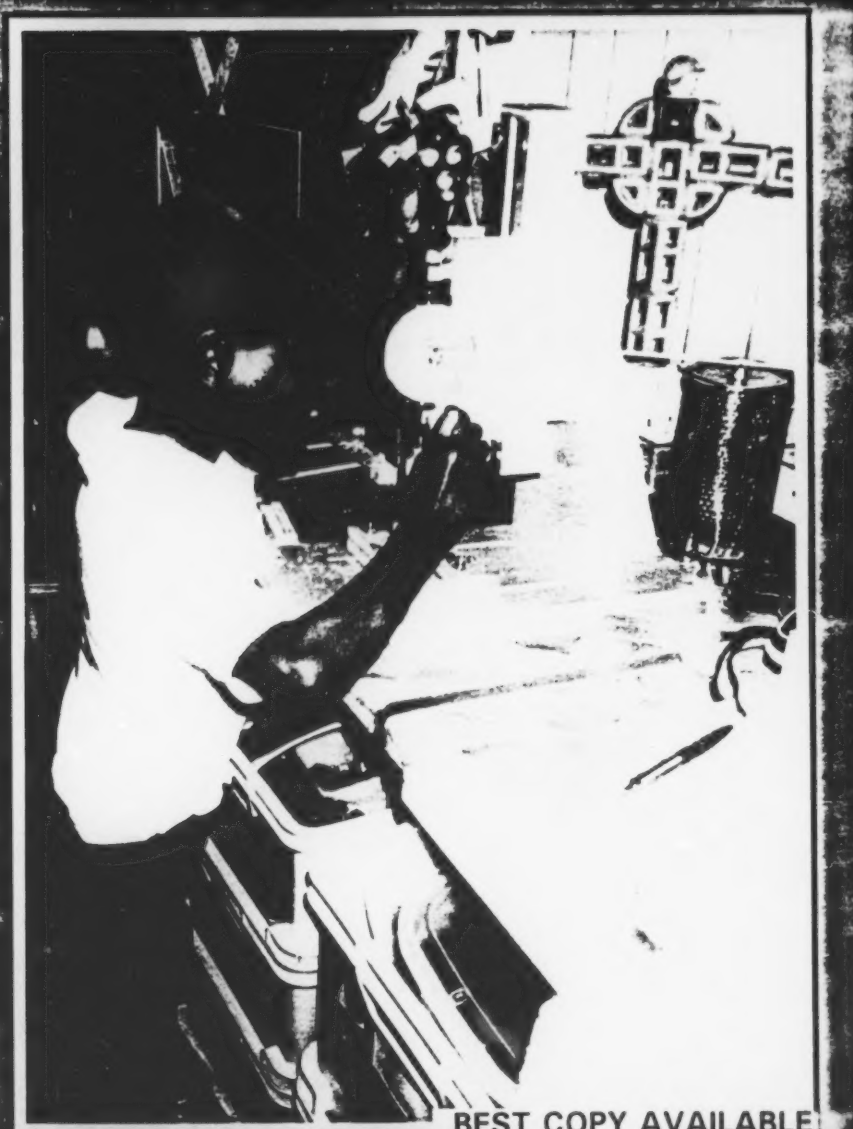

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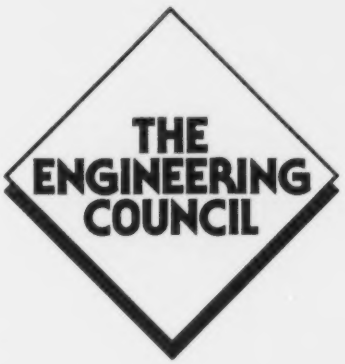

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The textbooks are available at a cost of £10.00 each or at £45.00 for the omnibus version of the 5 textbooks. Please add for postage and packing: £2.00 for orders up to £10.00; £3.50 for orders between £10.00 and £40.00; £5.00 for orders between £40.00 and £50.00; £7.50 for orders over £50.00. Cheques enclosed with orders should be made payable to '*The Engineering Council*'.

To place an order for textbooks, to receive sample pages, or to receive full information on the TEP programme, please contact Virginia Harris at The Engineering Council, Essex House, 12/13 Essex Street, London WC2R 3EG. Tel 0171 240 7891; fax 0171 379 5586.

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Volume 27 Number 2 1995

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Editorial

John Eggleston

Once again we present an issue of *Design & Technology Teaching* that offers information, stimulation and amusement to all our readers.

We begin with Bob Welch's Maurice Brown Memorial Lecture given at the Design and Technology Exhibition this year. Taking a long-term perspective he reminds us that, despite all the upheavals and U-turns in our subject, in design and technology 'our aim is to ensure quality teaching and learning' — an aim which can lead to 'elegant' solutions to practical problems. An important part of Welch's mission is also to ensure that the current range of National Curriculum prospects is not only coordinated but 'becomes embedded in the curriculum fabric of schools'. Perhaps most welcome is his up-beat conclusion:

> Let us continue to celebrate the best and convince all that D&T is not in a mess, it is not a problem, but it is an area of the curriculum which is dynamic, unique and above all forward-looking and a joy to teach. We do need a national campaign to take us forward.

Eggleston's article also seeks to enhance quality and optimism by suggesting how we may make technology and design education more attractive and interesting to our pupils and students. Based on his keynote lecture at the World Conference of Technology Associations a few weeks before Welch's lecture the message is similar — how to take our subject forward to higher standards of teaching and learning.

Rob Johnsey, in an important article, takes the issue further asking how we can recognise and evaluate our achievements — particularly in the primary schools — reminding us that

> Design and technology is not just about pupils designing and making products, it is about their wider understanding of the designed world.

The interview with Jensen also continues the search for standards as do the illuminating articles by Durrell, Forman and Etchison and Egan. There is also a series of articles on systems and electronics by Jones, Steeg, Bostock and Howard. Hawkey's fun guide to electronics terminology which will be displayed on very many D&T noticeboards for a long time to come.

Meanwhile DATA is not only participating actively in the national scene: it is recognising that its strengths must always spring from the individual member's interests. Accordingly, in addition to its national activities DATA is embarking on a major programme to meet members and potential members in regional meetings up and down Britain. From March to May over 20 meetings are scheduled — each with a personal contribution from the new Chief Executive Andy Breckon.

The message is clear — read *Design and Technology Teaching*, join DATA and make your views known!

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The Maurice Brown Memorial Lecture *Teaching Design and Technology in a Changing World*

Bob Welch Inspector for Technology, Berkshire LEA and Honorary Secretary of the National Association of Advisers and Inspectors in Design and Technology (NAAIDT)

The Maurice Brown Memorial Lecture at the D&T Exhibition 1994 was given by Bob Welch, and we are pleased to reproduce most of it here. Regrettably, some parts — a slide showing the bonfire Bob made of past National Curriculum consultation documents, for example — have had to be omitted.

Previous speakers have taken the opportunity provided by this forum to make a contribution to the current debate and in many ways, nail their own particular set of colours to the mast. I do not intend to break with this tradition and I hope that what I will be saying tonight will not only be of interest but also moves the debate on and enables us to perhaps look beyond the current preoccupations with statutory Orders and day-to-day matters associated with the teaching of design and technology in schools.

I will be mentioning some of the changes to the statutory Order and the implications for schools and teachers, but tonight's talk will be very much personal thoughts and reflections on the current scene. Perhaps I should also at the outset make clear that this evening I will try to limit my references to the National Curriculum Orders and also, wherever possible, restrict my comments concerning the inspection of schools under the OFSTED framework.

After I recovered from the initial shock of being asked to present this lecture I must say that I enjoyed undertaking some background research into the areas I will be covering. I have been able to delve back into the archives and dust off a few old books and re-read some of the articles which influenced my thinking early on. I also looked through my collection of photographs and slides taken over the last fifteen years or so. This I must say was a great pleasure, as it was good to be reminded of what we have achieved in schools.

Photographs of primary school technology fairs and exhibitions of O level, CSE and A level design work all raised fond memories. They also reminded me that design and technology was alive and well in schools before programmes of study, attainment targets, design and make assignments and other National Curriculum paraphernalia.

I have never thought myself to be old but I think that old age is creeping up on me because, first of all, I remember when we could get into museums for nothing; the Science Museum and the Victoria and Albert were second homes to me as a boy. Secondly, I remember when learning a musical instrument at school was free; at the newly opened school I went to in south London I was not only encouraged to learn to play several musical instruments but also the heads of physics and what was then technical studies were developing a new course in what would now be called control technology. Thirdly, I cannot remember having PSE lessons at school. Neither, I suspect, did I or my friends at school work so hard, or suffer such pressures, as children do today.

I came across a booklet published as a colour supplement in the late sixties. It contains an article about the school of the future, the school of 1990. In this school there were no teachers, only facilitators. There were no lessons, only optional seminars and the principal method of teaching and learning was through the use of computer terminals linked to an extensive mainframe computer. Some of this revolution has taken place but other predictions, with the great benefit of 20 20 vision hindsight, have been shown to be false.

Whilst looking to the future, we should not forget our past for if history teaches us anything it is that history teaches us nothing. There was no Golden Age as far as technology in schools was concerned but there were some nuggets of excellent practice which glistened and shone out to inspire others.

Whilst some, and I emphasise *some*, of the work I see as an inspector and in my visits to schools to offer advice is mundane, repetitious and poorly thought out, there is always something to excite. There is nearly always some work by perhaps only a small number of children which creates a buzz in the mind. What are the words I use to describe this work? Yes, the outcomes are successful, they do what they have been designed to do and do it well. Yes, the outcomes make efficient use of materials and are well made. But there are other important words: *elegance, flair, gosh!* They are words to do with feelings, not words to put in level descriptors or try to explain using other words. But they are words which spring to mind when you see the work and talk with the pupil. The product is *elegant*. An *elegant* solution to a fascinating problem.

The current scene

What is the current state of play? In secondary schools, technology challenged the status quo. It did not sit comfortably with existing patterns of staffing, accommodation or curriculum organisation.

Compulsory technology for all pupils in Key Stage 4 came as something of a shock to some schools — particularly to parents and governors who had either not been informed or

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led to believe that it would not actually happen. Some colleagues in other subject areas also recognised the implications for their subject in option schemes when technology for all arrived.

When it did happen there was some gnashing of teeth and threats to boycott, but most schools took the plunge, modified option schemes, and went ahead with the new suite of courses. The new courses in some instances became unwieldy and teachers were concerned that pupils' performance would suffer.

Then came the news that the requirement to study technology would be temporarily suspended for two years. There was joy and rejoicing in those schools who had done little and tears and sorrow from those of us who had worked hard to get the notion of technology for all established firmly in the culture of schools.

Primary schools were, and still are, under pressure to ensure mastery of basic skills, particularly in the core subject areas. Curriculum time is precious. How many primary schools, I wonder, teach design and technology in the morning, when minds are fresh? How many leave it until the afternoon? How many leave it to Friday afternoon?

Issues

I chose the title for this lecture — 'Teaching Design and Technology in a Changing World' — for a number of reasons. I wanted to concentrate on the key word *teaching*, and hope to offer some support for a group of people who I truly believe feel embattled, deskilled, beleaguered and stressed through the constant changes they have seen in recent years. Most sad for me is when I meet teachers approaching retirement who do so with mixed emotions, pleased to be relieved of the strain but saddened by a lowering of standards and unsure that what they achieved in their professional life was valued.

Teachers of design and technology in our primary, secondary and special schools are central to any notions we might have of raising standards and improving quality. Teachers are central to encouraging young people to do well and to enjoy our subject. Finally, teachers are also central to developing the subject area and moving it forward.

It is a sad fact that one unplanned side-effect of the introduction of the National Curriculum has been the growth of a general lack of confidence amongst teachers. Their good work, *your* good work, over many years, their enthusiasm, *your* enthusiasm, their inventiveness and sheer flair has been sapped by too many initiatives, mountains of paperwork and a general lack of clarity in expectation of what is required and what could be considered good practice.

When D&T was first introduced in the National Curriculum some pundits claimed that this was a *totally* new area of the curriculum. Not only were such statements arrant nonsense, they also devalued the work which had been taking place in many schools over many years trying out ideas, developing curriculum material and producing examinations with wide acceptability. It was nothing less than an insult for many teachers, advisers, lecturers and project teams nationwide.

The title refers to a changing world. We live in a rapidly changing world in many ways and not least in the world of education. The sheer pace of technological change has been staggering. To put this in perspective, although it did not actually happen, it would have been possible for the first man to fly, Orville Wright, to have discussed his experience with the first man in space, Yuri Gagarin, and the first man on the moon, Neil Armstrong. The technological developments from the first fragile aircraft to the sophistications of a moon mission took place in one lifetime, with only 66 years between the two events.

I myself span a major technological change in the area of electronics. As a boy I used to keep warm from the glow of thermionic valves in the back of my radio. I had to remember to switch the wireless on before the start of the programme to allow the thing to warm up. I also remember the white spot on the television tube when you switched it off. This all changed with the invention of the transistor and I spent some time in my youth soldering components together and making printed circuit boards. During my time at university, the first microchips appeared and I can remember spending many hours trying to understand the workings of the microprocessor.

Thus in my own lifetime the technological developments have been such that, not only has the consumer electronics boom continued unabated but we as a society rely more and more on technologists finding solutions to problems and improving the quality of our

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lives. We might not be able to agree a definition of it but we rely on technology and place great faith in it.

Such rapid changes, which of course continue, have serious implications for the teaching of the subject in schools. Just what are the core areas of knowledge and skills which all pupils should know, understand and do? It is a question which we have struggled with and continue to struggle with since the subject started to be taught. Some have concentrated on the process skills of investigation, research, identification of need, planning, making etc. Others have sought to define key concepts and areas of knowledge in elements of technology such as control, structures, materials and energy. The problem which arises when one defines a subject solely as a set of process skills is that it can be difficult to decide whether one has a subject at all.

Some attempts to define technology have produced definitions which embrace all human activity and others use technology as a convenient description of generalised problem solving activity. This has particular consequences for schools. There must be a clear distinction between a cross-curricular activity, one which draws on knowledge and skills from a number of subject areas, and a mechanism for delivery which is cross curriculum. Too often in the past this point has been confused.

Let me illustrate with an example. I used to go into many classrooms where groups of pupils were making towers from drinking straws. The children were generally enjoying themselves, talking constructively and thinking about what they had been asked to do. They were learning to co-operate with each other, ask questions and experiment with materials. I had to ask myself whether the activity was developing each child's technological capability. Today I would have to ask whether this was a design and make assignment, a focused task or a disassembly task.

Clearly, learning occurred and the task provided good opportunities for developing communication skills. However, was it technological or perhaps PSE? I concluded that it could be either. It could be technological if the teacher was guiding the pupils to ask certain questions. Questions such as 'Why did you choose that shape/are triangles important to your tower/what is the tower for/why did you join the straws together in that way/are there other ways of joining the straws?'. In essence, it all depended on teachers asking the right questions.

Thinking about asking the right questions, I said at the start of this talk that I would not say much about OFSTED inspections. I will, however mention a couple of points. I believe the OFSTED framework is and will continue to be a powerful influence on the management of schools and the curriculum. The criteria for evaluation are explicit and published for all to see.

NAAIDT organised a one-day conference for OFSTED inspectors to look at the issues associated with standardising judgements in the subject area. This was very successful in enabling inspectors to discuss their experiences. This was very valuable and I believe NAAIDT was the first advisers' association to do this. We need to do much more as (and this may come as some surprise) there is no system set up by OFSTED for subject-specific training and support of this kind. The seminars here given by NAAIDT will give you much more information about what we have found in schools. Inspection has a crucial role in helping schools plan beyond the minimum requirements of the National Curriculum.

This term has seen the start of the inspection of primary schools where our subject is less well embedded in the curriculum culture. My own thoughts are that, particularly at Key Stage 2, design and technology is receiving less attention than in previous years.

Cynics might suggest that this could be linked to the fact that as a subject, it will not be statutorily assessed but, more likely, it is due to the sheer overload placed on schools by the National Curriculum prior to the Dearing review. What I do perceive, however, and this is most worrying, is a growing differential between schools with some pupils receiving a rich entitlement of design and technology whilst others receive little, if indeed, any. It will be interesting to read the first OFSTED primary reports to see what trends are emerging.

We certainly have no shortage of issues facing us. Vocational education, the new funding agency for schools, local government reorganisation, the end of TVEI, concerns about standards in public examinations, the

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implications of the information superhighway, changes to initial teacher training, the list goes on and on. It is now time, however, to look for some strategies.

Strategies

I have for some time thought that those working in the field of technology would welcome some guidance and clarity of vision for the future. Teachers, lecturers, advisers and inspectors, suppliers and those working in a range of support agencies I believe need some unifying agent to restore coherence and provide confidence it what we are all trying to achieve.

I perceive a growing gulf between the best practice in schools and the work taking place in other schools. This chasm has to be bridged and, as Lloyd George once remarked, you do not cross a chasm in two short leaps. You need a major campaign.

I have been considering what to call this campaign and one possibility was the Campaign for Real Technology, or CART for short. This has the advantage of being easy to remember and relates to other successful campaigns concerning real ale and real bread.

I think that there is a need for a national initiative in this area to bring together the various groups who all have something to offer. It must be very confusing to observers outside the world of D&T to come to grips with the plethora of projects and initiatives taking place in this area. In one respect, such a diversity of projects is good news as it shows that the curriculum is alive and well. It shows that people are interested and willing to invest their time and not inconsiderable resources to support our subject in schools. On the other hand, it can all be somewhat confusing and lead in some cases to repetition and re-invention of wheels. Another factor which is worrying is the propensity for support projects to be launched with great skill, attracting much attention, work to benefit some schools but then, due to cessation of funding or other factors, cease to exist and not, most sadly, become embedded in the curriculum fabric of schools. Such national projects play an important role in developing the curriculum and would be key players in my campaign. These agencies offer concrete help to teachers.

Help is also available to teachers from other sources. Teachers of technology are relatively well supported when compared with other subject areas. What other subject area has a termly free newspaper multiple copies of which are sent to all schools? I am referring to the excellent *Design and Technology Times*, unique as far as I am aware as a subject-focused free paper for teachers.

There are major national projects including the work taking place at the Royal College of Art and the work of the Nuffield project. There is also the initiative of the Engineering Council to produce much-needed resource material in the area of control technology. Much of this rich range of material is of relevance to Key Stages 3 and 4 and I know that project teams are keen to extend the work to cover all phases. There is also a great need to develop resources for use in special schools and to support the less able pupil in mainstream education.

This annual exhibition of resources for design and technology at the NEC and its increasing programme of seminars throughout the three days has become an important date in the diaries of many teachers. HMI and OFSTED have produced and continue to publish valuable resource material. I must also mention DATA, the Design and Technology Association. The need for such a national body with the status to represent our subject in high places as well as support teachers is clear.

It would be somewhat presumptuous of me to tell DATA what it should be doing but I would like to offer just a few thoughts for the members of DATA to consider. It has taken some time to become established but under the guidance of its new Executive Director must now meet the challenge head on. It has a crucial role not only in co-ordinating the myriad of initiatives in this curriculum area but also taking a lead by setting the future agenda for change and helping to shape the subject in schools. It is vital that a policy statement is agreed and a development plan, fully costed with manageable targets, is produced. I am sure that this is well in hand but I would wish to stress the urgency of this if progress is to be made and losses suffered over the last few years are to be recovered.

An agenda for future action has already been proposed in an excellent article by Alan George, education liaison manager for Unilever, published in the DATA's *Design & Technology Teaching*. The recent DATA

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conference at Keele also gave clear pointers to the way ahead.

Here are my own thoughts about a mission statement and some targets. The information published in the recent DATA reports can provide the baseline for measuring improvements over the next five years:

Our aim is to ensure quality teaching and learning in design and technology

By the year 2000:

- *All primary teachers to have greater confidence*
- *All secondary schools to have sufficient, qualified staff*
- *All schools to have an appropriate range of materials, accommodation and resources*
- *Parents, governors and industrialists to better understand the unique place of D&T in the curriculum of schools*
- *Numbers of pupils taking A levels in D&T to have increased by 2% each year from 1995*

Who else can help with my campaign? There has never been a shortage of advice for teachers. One of the books I came across during my researches was *Practical Schools Method*, published by the Normal Press Ltd. It is a manual for teachers and those directly concerned or interested in the practical work of education. It is a fascinating read and very helpful. It covers all aspects of teaching including discipline, lesson preparation, and general principles of instruction. It lists the qualities of a good teacher and this might be of interest to those concerned with admissions to teacher training courses or the recruitment of staff. You will have to tolerate, I am afraid, the writer's view that all teachers are male.

'A teacher must be well equipped with suitable qualifications.' The teacher must be patient, tactful, kind, cheerful and courteous with perfect self-control and command of temper. 'A teacher must display earnestness and uprightness of character.' A teacher must have a thorough knowledge of his work; the teacher must not only know what to teach, but also why he teaches it and how to teach it. 'He should have common sense views about children and the best methods of managing them and a continual desire to extend their own intellectual acquirements. Finally, a teacher must have 'a strong constitution, a considerable amount of bodily energy, quickness of eye and ear and, some proficiency in national games is often also desirable.'

So there we have it, the qualities of the ideal teacher. Little mention of the ability to assess pupils' attainments, little mention of record-keeping skills or coping with continual imposed change and no mention at all about skills in marketing the school in a climate of open enrolment.

This little book also contains guidance on planning for progression (although it does not of course use the word). 'Proceed from the known to the unknown, proceed from the simple to the complex, proceed from the indefinite to the definite and finally, proceed from the concrete to the abstract.'

There is much else to do with general teaching method, class control and the teaching of various subjects. Unfortunately there is no section on the teaching of design and technology. There is a section on manual training, which is a term used to describe various forms of practical activity which serve to train the hand and the eye and stimulate aesthetic taste. In other words, the head, the hand and the heart.

Finally, and right up to date, the author, one J. H. Boardman BA, late principal of the Douglas PT Centre writes: 'Besides the foregoing advantages, it is of the highest importance to remember that the continuous training of children in useful manual work throughout their school career is an essential factor in maintaining the industrial prosperity of the nation'. Although the terminology used would be different today, much of the sentiment would remain the same, particularly the emphasis on all children undertaking work in this area.

As I have said, there is no shortage of advice for teachers of practical subjects. An article published in 1935 gave some sound advice to teachers who were worried that their lessons were becoming a little stale. I will just restrict my self to two short quotations. 'Get the students' viewpoint. Make up situations so that they will say what they think. Find out what they would like to make even if they can't make it. Persuade them that they can't later. But, if they can, let them make it' and secondly, 'Keep up with the times. Some teachers don't. The atmosphere in their

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workshop betrays them. The world has moved on while they have remained fixed'.

Some might think that help is at hand in the form of National Curriculum Orders. There will also be non-statutory guidance, the status of which has always presented something of a problem. I understand that the NSG will at least this time be published alongside the Order.

The purpose of a National Curriculum Order is by now, I hope, clear. It sets out those aspects of a subject which should be taught to all pupils and an indication of what progress can reasonably be expected to be made over a period of time. It should provide sufficient information for teachers to plan suitable schemes of work. What an Order is *not* is a definition of the subject or everything you wanted to know about how to teach it.

The Order for art does not define what art is, neither does the Order for any subject. Neither can an Order define any particular teaching style or means of delivery. This is a matter for the professional judgement of teachers. I do not believe that the professional would want to be instructed in how to teach any aspect of a subject or what precise proportion of a teaching week should be devoted to the teaching of any subject.

The new set of Orders has now been published. Many aspects of the new Orders have been welcomed including the centrality of designing and making and the requirements for all pupils to continue a study of design and technology in all four key stages — at least in England. Concerns have rightly been expressed concerning the degree of detail needed in a statutory Order, particularly one which will see no major changes, we are told, for five years.

This new set of Orders really is the minimum requirement. It buries for ever the myth that D&T is an amalgam of five subjects. The expertise to teach D&T lies with teachers from various subject backgrounds. The new Order goes one stage further. The need will be for teachers to read the programmes of study and the knowledge and skills to be taught and then select the most appropriate material or materials to use.

We see a reduction in the prescribed content, particularly at Key Stage 2, in response to comments made by teachers during the consultation period. One element which has gone is the requirement for pupils to learn about the work of distinguished engineers, designers and technologists. Whilst I understand the pressure on time I hope that this element will remain in the work as it does make pupils aware of the design and technology heritage which is theirs.

I have a small concern that the disassembly tasks may become an end in their own right rather than used to inform design and make assignments. We need to think about what we want pupils to gain from such disassembly tasks. Taking things apart to see how they work is fine, and this would more accurately be called dismantling. But disassembling is more analytical. Some have commented on the need to include assembly skills as well as disassembling and we could see groups of pupils all doing this at the same time — collective acts of assembly. We should also remember that whilst taking a clock apart tells you something about gears and springs, taking a digital watch apart will not reveal much about how it works as the black microchip remains mystic and magical.

To return to the Order, the level descriptions have also caused concern, particularly linked to their interpretation, by teachers across the country. The move away from statements of attainment may avoid over-use of tick-boxes but I doubt whether the management and staff development needs will be lessened in any way.

Consistent and coherent interpretation of the level descriptions will demand much in the way of inter-school moderation. Such moderation meetings, where they took place as part of CSE, GCE or GCSE examinations, provided a valuable opportunity for staff development and allowed consensus views of standards to be achieved. Moderation meetings, and I remember many of them, were not cosy affairs and sometimes heated debates took place about the allocation of marks to a particular pupils work. However, the pain was worth the gain in sharing school practice and ideas. Assessing D&T capability is a developing art calling for professional judgements to be made. We have moved a long way from the crude instruments used in previous years.

Openness

Something else we need is openness. In order to help our cause we must enlist the help of the media. Now, over the past few years the educational and national press have given

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mixed reviews about technology in schools. The media will always be more interested in a story which contains problems rather than successes. However, I am sure that we can harness the press to our cause by skilful selection of stories and making sure that we celebrate the best work taking place in schools. By all means debate and discuss the key issues, by all means air your views about what concerns you but, if we are to form a strong alliance, then perhaps sometimes the best means of communication may not be the letters pages of our newspapers. As I said we must celebrate the best but reject the mediocre and mundane.

Resources

What we must also have is resources. Resources in terms of equipment and materials for pupils to experiment and try out ideas. The environment in which we teach the subject must be welcoming and stimulating. A child entering a design and technology room should be excited by all the possibilities which now confront him or her. Design and technology should be the highlight of a child's week in school, whether it be a primary school, a special school or a secondary school.

If we are to achieve this then there is a need for a substantial investment of resources in *all* schools. Not just the CTCs and TSI schools, *all* schools. Such resourcing must be carefully targeted and its use monitored to ensure that appropriate priorities are established and adhered to. It is all too easy to spend large sums of money on computer networks without necessarily establishing the teaching and learning priorities.

We must also ensure that class size does not limit the achievements of pupils. This has been a long-standing issue as this quote from the minutes of a conference, held in Birmingham in 1935 illustrates:

> The following resolution was put to the vote and carried. That this conference protests against the practice of certain HMIs of Secondary Schools, advocating that one master shall be responsible for a full form of 34 to 36 boys at handicraft; and that this Conference recommends to the Board of Education that no class for handicraft instruction shall exceed 20 boys per qualified teacher.

Of course we no longer teach handicraft but the issue of class size will not go away. Some headteachers have argued that, given the reduced emphasis on practical work and the increase in paper-based and investigational work, larger group sizes are acceptable. Very few headteachers have taught the subject and understand the demands made of teachers of practical subjects.

Evidence from OFSTED reports is that group size in secondary schools is increasing. This trend must be stopped and the only way to do so is with hard evidence that the nature and scope of the work is restricted and standards achieved are lowered. This of course is difficult to do as all teachers want their classes to do well and want them to succeed. Some areas, such as Northern Ireland, have an agreed maximum for class sizes in practical subjects. This has never been agreed in England and Wales to my knowledge but could be, particularly if the case was argued strongly by a General Teaching Council and, of course, DATA.

Support

After help, openness and resources we need support. We need the support of parents, employers and politicians. But teachers also need the support provided by independent, well informed, locally based advisers and advisory teachers. It is all too apparent that some existing structures for support are being dismantled with the result that the provision of advice to schools is becoming very varied across the country. At a time when schools need the support provided by small locally based networks, such networks are finding increasing difficulty in surviving.

This may sound like special pleading but I do believe that well managed teams of advisory teachers, working alongside other teachers in the classroom and providing sound advice on resources and curriculum material have shown themselves to be most effective and helped to promote best practice in schools. I am fortunate that in my own authority we have managed to retain a strong advisory team and have indeed recently moved our design and technology centre to new premises.

In-service training

Finally in this section on support, I want to mention in-service training. This is an area which is rapidly reaching a crisis point. The

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devolution of funds to schools has had a number of effects, some positive and others detrimental. Positive in the sense of greater school involvement in planning for staff development and providing schools with the ability to ensure courses are relevant to their needs. Other effects have been a tendency for schools to devote funds to school-based initiatives, generally linked to whole-school management issues.

In-service training in design and technology is time consuming. It is not subject to quick fix solutions through twilight sessions after school at teachers' centres. Teaching design and technology can be a physically exhausting activity and, after a long teaching day, it is wrong to expect teachers to undertake detailed curriculum study. One other effect of the change in funding arrangements has been the reduction in teachers undertaking further professional study at higher levels including research degrees.

Teachers in all phases, and particularly primary school teachers, need extended periods of time to study the knowledge base associated with the subject and to undertake substantial design and make projects for themselves. They also need time to develop schemes of work and strategies for supporting the work of other teachers in their schools. The 20-day courses funded from GEST have provided a much needed opportunity for such INSET to take place.

This was — and I find this staggering — the first national INSET programme specifically targeted on design and technology in primary schools. In previous years there has been support for science and mathematics but nothing specifically for D&T. Just as these courses have become established, the rules have again been changed and the funds available stretched to cover all National Curriculum subjects and suggestions that the course could be shorter. One has to question the value of a five-day course in D&T and what can he achieved.

We have to continue to attract the best people to teach D&T. Some time ago we had a shortage of teachers in Berkshire schools and I suggested we undertook some careful advertising designed to appeal to potential teachers. Unfortunately, this campaign was rejected.

Some newly appointed teachers are proving to be excellent, both in their knowledge of the subject and their enthusiasm to teach it. Sadly, however, too few primary school teachers receive sufficient grounding in the subject as part of their initial teacher training.

Examinations

Finally in my list, we cannot ignore examinations. Let me touch on one aspect which is not often raised: the development of examinations such as the CSE, GCE and GCSE. In the field of technology, many innovative and successful teaching schemes could be accredited through the examination agencies, principally through a Mode 3 route. What would happen would be this. An enthusiastic teacher would develop a course of relevance to the pupils in his or her school. They would approach a local examination board and ask for the course to be accredited. A panel would look at the syllabus and an external examiner would ensure standards were maintained.

Such a system encouraged the teacher but also had one important secondary effect. As more teachers got to hear about the course other schools entered pupils and the new course caught on. In time the course might evolve to become a Mode 1 CSE and be offered to all schools. Thus the initiative, enthusiasm and vision of one teacher could be harnessed to move the subject on. All this was swept away by the cold hand of centralised bureaucracy.

The flaw with the system was that large numbers of courses, sometimes with exotic titles, were being offered at examination level. Some felt that a CSE in *Street Artistry and Juggling* was an inappropriate qualifications for a 16-year-old. Technology was an area of the curriculum renowned for the proliferation of subject titles. Early TVEI schemes encouraged the development of new courses and the list of qualifications became longer and longer. Some titles were frankly bizarre and only made sense to the syllabus developers. I remember seeing a course called *Technology across the Curriculum* and wondered what an employer would make of a young person with a qualification in this area.

The system needed to be tightened but in so doing I believe that the enthusiasm and commitment of the individual was smothered. It takes a long time to write a syllabus and the associated assessment scheme and few were

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willing to go through a long and tortuous path in the hope of receiving approval from an increasingly restrictive system working to sets of complex criteria.

So now we have H for help, O for openness, R for resources and S for Support and E for Examinations. This seems to fit well with my notion of campaign for real technology. But perhaps my E is a little narrow. E should stand for enthusiasm, energy, excitement.

Having looked at my cart and my horse I now become worried. Is a horse-drawn cart really the image for the end of the 20th century? It reminded me of the first mobile teaching resource unit. I am proud to say that this was in Berkshire in 1888. In fact, it was one of the first things that Berkshire County Council did.

We recreated this travelling wagon for a local show to celebrate one hundred years of the County Council. It was perhaps somewhat ironic that we had no difficulty at all in finding the forge, tools and equipment to recreate the wagon. We did not have to go to the local antiques shop but only had to visit a couple of local secondary schools. Out with the horse and cart. We should be using the image of the high-speed EuroStar express train or the new generation of supersonic aircraft. But even perhaps these technologies are becoming outdated. A better method of travelling would be a Star Trek transporter to beam us up to where no one has been before. To boldly go to futures unknown.

The future

Let us look at what might happen in the short term, towards the year 2000.

We do have friends in the world beyond schools who understand what our subject has to offer and why it should form an essential component in the education of all children. For example, Article 127 of the Maastricht treaty pledges the European Community to implement educational policies which facilitate adaptation to industrial changes. We must capitalise on this and draw the attention of central government to the implications. Closer to home, a recently published report from BT complimented another from the CBI in highlighting the need to prepare pupils for a multi-skilled, technological future.

For the BT report, *Matching Skills*, a team of teachers investigated the skills required for companies of the future and then related this recent changes in the UK education system. They listed the needs in three areas:

Future knowledge needs
increased technological competence

Future skills needs
acquisition and development of core skills

Future capability needs
how to be flexible, adaptable and cope with uncertainty

The list of important capabilities was particularly interesting and included the need for people to be flexible, adaptive and innovative, to exercise leadership and cope with uncertainty. These are all qualities developed through D&T activity.

In the area of specific skills the report concluded that young people needed to be technologically educated, technologically literate and able to exploit varying technologies, able to adapt to new technologies and prepared to understand the changing nature of the world of work. If a D&T course does not cover such activities then do we have any right to insist that all pupils take the subject?

I believe that design and technology has a bright future in our schools. It may have been through troubled times but the struggle remains worthwhile and we must all maintain the momentum which has been achieved so far. We will continue to have setbacks and be called upon to defend our place in the school curriculum. We must believe in what we do and, to adapt a quote of Matthew Arnold who said 'You will only find the Holy Grail if you believe in it' — you will not succeed with D&T unless you believe in it.

Let us continue to celebrate the best and convince all that D&T is not in a mess, it is not a problem, but it is an area of the curriculum which is dynamic, unique and above all forward-looking and a joy to teach. We do need a national campaign to take us forward. A campaign which involves all the stakeholders; teachers, parents, industrialists, project teams, researchers and academics, suppliers, central government, SCAA, OFSTED and the most important stakeholders of all, young people in our schools and colleges.

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A 'Smith & Jones' Guide to Electronics

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If you are still having difficulty digesting the New Year fare and the new Technology Order, Roy Hawkey's sideways glance at the vocabulary of electronics may help.

One of the problems confronting the learner (and hence the teacher) in any subject lies in becoming familiar with specialist vocabulary. Technology is no exception to this, and its difficulties are often compounded by the use of terms in particular ways where the precise meaning may be different from — or even conflict with — 'everyday' usage. Examples which readily come to mind include (from the realm of materials) *hardwood, plastic* and *brittle*, or (from the domain of machines) *force, energy, power* and even *machine* itself.

One approach to this linguistic dilemma is that of the humorist, in which ambiguity or incongruity provide a potential deliberate challenge to understanding. Whether the essential element is provided by the forces encountered by a bricklayer (Hoffnung in 1954) or other areas of knowledge and understanding (Hawkey, 1995), much of science and technology can be successfully addressed in this way. The dialogue which follows applies this style to electronics, in the style of a head-to-head between Mel Smith and Griff Rees-Jones.

Mel: Do you know what this is?

Griff: No, what is it?

Mel: It's a chip!

Griff: Get away — there's no grease on it and it doesn't smell of vinegar.

Mel: Not *that* kind of chip — a *silicon* chip.

Griff: Has it been cooked in silicone grease, then?

Mel: No — it's electronic. Like in radios and TVs — transistors and all that.

Griff: Oh yeah, I remember. They grow them in silicon valley in the US — Texas, I think.

Mel: They don't *grow!* They're made from sand.

Griff: You don't expect me to believe that, do you? Last week you tried to tell me that *glass* was made from sand!

Mel: Well, it is — and so are micro-chips.

Griff: What do they do then, these micro-chips?

Mel: They're part of electronics systems: very small transistors and resistors and diodes —

Griff: — Hang on a minute — resistors? Wasn't that, you know — like *'Allo 'Allo* — in the war?

Mel: Resistors, not resistance!

Griff: And this *diode* — sounds like a Welsh poet!

Mel: Don't you know *anything?*

Griff: Not this science and techno stuff, no. It didn't seem to be important when I was at school.

Mel: Well, it is.

Griff: So what about these chips? What do they do exactly?

Mel: Transistors are like valves: they decide whether to let stuff through or not.

Griff: My Grandad had a valve replaced, in his heart. Did they put a transistor in, then? Or a chip?

Mel: Not that kind of valve — *electronic* valves.

Griff: What do they do, then?

Mel: They, well — they decide to let current flow — or not.

Griff: No currants without a good raisin, eh?

Mel: Oh, very funny.

Griff: And what about these diodes? What do they do?

Mel: Well, they — they — sort of . . .They're important.

Griff: You don't know, do you? It's all pretend with you. You don't really know any more than I do.

Mel: That's where you're wrong! I know *exactly* what diodes do. They . . .they let electricity flow one way but not the other. So there!

Griff: What use is that, then?

Mel: Well . . . I'm not exactly sure. I know it's important though. Something to do with all those integrated circuits and micro-processors.

Griff: There you go again, using all those big words. Aren't there any simple things in electronics?

Mel: I don't suppose *gate* is simple enough, is it?

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Griff: That sounds all right. Garden gate?

Mel: No, *logic* gate. There's three basic types —

Griff: — Five bar, rustic and —

Mel: Just listen, will you? They're called NOT, AND and OR . . .

Griff: Or they're called, and not or. Or not and... Well, I've made a decision: I've had enough. I'm bored by all these circuits.

Mel: Is that supposed to be funny? Circuit board?

Griff: I don't know enough to make jokes. I don't have the capacitance.

Mel: That's where we're different. I can't leave everything in a state of flux.

Griff: While I'm happy just to solder on.

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Voltless Electronics at Key Stage 3

Paul Jones

Ralph Allen School, Bath

For many students electronics seems abstract and confusing; Paul Jones suggests a simple way of introducing this area of technology to support work at Key Stage 3

According to the draft proposals for the National Curriculum for Technology, KS3 pupils will still be expected to carry out designing and making tasks involving the application of electrical and electronics control systems. For many teachers, however, the delivery of electronic design projects at KS3 presents something of a dilemma. Quantitative electronic theory would appear to be a fastidious and unnecessary extension of what is required by the National Curriculum, yet without some knowledge of electronic mechanisms, must often be restricted to prescriptive projects that give little experience of the nature of designing with electronics. Enthusiasm can thus be dampened for this important and powerful area of technology, and frustrations may arise when circuitry fails and the student is not equipped with sufficient knowledge to find and cure the fault alone.

Is it possible for students to understand and design elementary electronic circuits (and also carry out some fault-finding procedures) without being overwhelmed by complex and quantitative electronic theory?

Simplifying the problem

For many students problems begin when electronic circuits are explained in terms of the three dimensions of voltage, current and resistance. In some simple but important circuits, however, the voltage can be considered constant and the problem then becomes two-dimensional. The behaviour of the electric circuit can then be explained by imagining 'electricity' travelling around the circuit and by considering the diminishing effect of each resistance, in turn, on this flow. The term 'electricity' may, in later studies, when Ohm's law is introduced, be characterised as having both power and current. In our simplified case, however, these two quantities rise and fall with each other proportionally, and there is little need to differentiate between them.

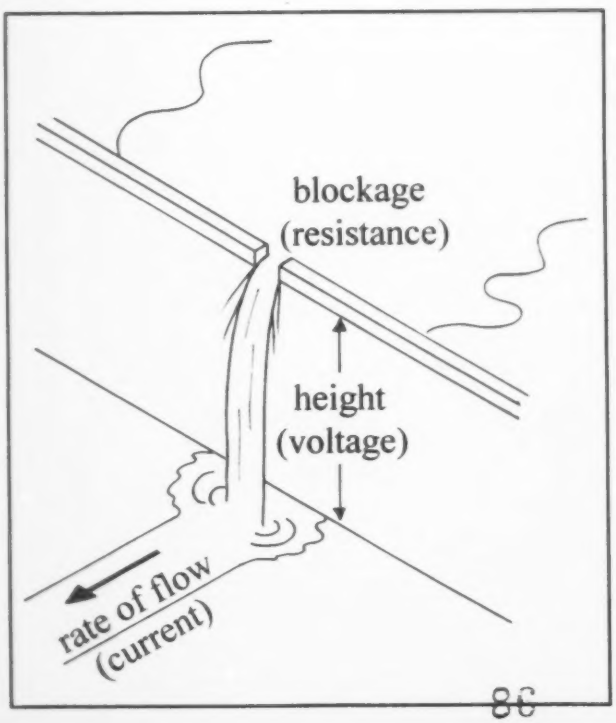
It is important that the limitations of this sort of analysis are understood by the teacher in order to avoid applying it to inappropriate situations. There is, therefore, no escape for teachers trying to avoid grappling with Ohm's law themselves, because only a full understanding of this elementary principle can avoid them wandering unaware into areas where a simplification breaks down.

First of all, then, let's look at the basis and limitations of the 'voltless' simplification. In the analogy of a waterfall flowing from an infinite reservoir, the voltage (V) can be considered as the height of the waterfall (see Figure 1). The resistance (R) is the amount of 'blockage' at the top of the waterfall. The current (I) is the speed of the water hitting the ground. Ohm' s law (R=V/I) tells us that a measure of the resistance (or blockage) is the ratio of the voltage (height) to the current (speed of the water). For example, if the water is flowing away from the waterfall very slowly and yet the waterfall is very high, there must obviously be a very large blockage at the top.

If the height of the waterfall is constant, however, then the speed of the water hitting the ground varies *only* with the blockage at the top. In this case the power with which the water hits the ground will also only be affected by the blockage, rising and falling with the speed of the flow.

Similarly, in the electronic circuit, if the voltage is constant, then the problem becomes two dimensional, since any change in current can be explained in terms of a change in resistance. Also, the power will vary simply with current, being affected only by the resistance at that point. For many small, simple circuits this simplification can be justified and allows an explanation in terms of 'electricity'

Figure 1



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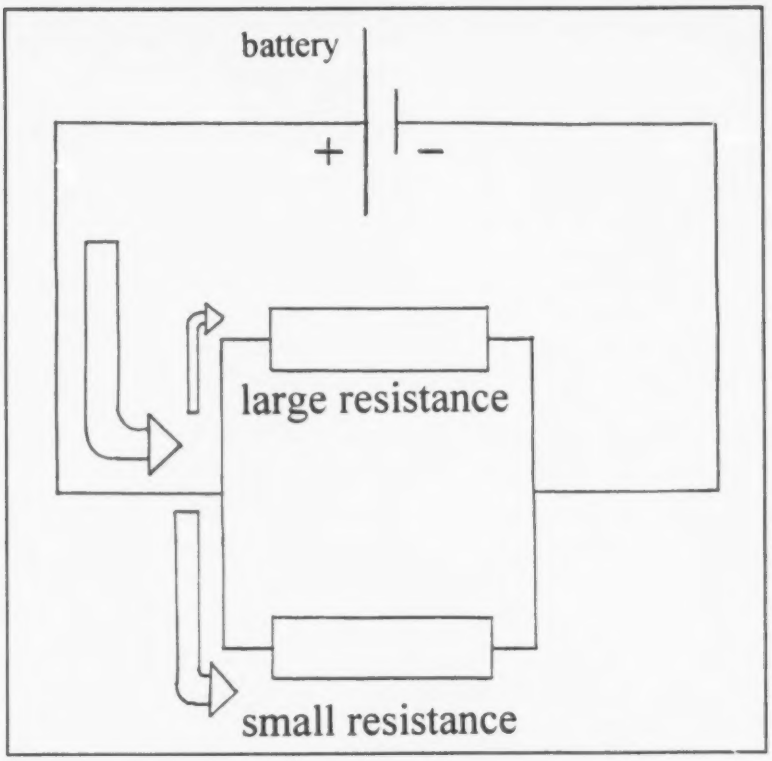
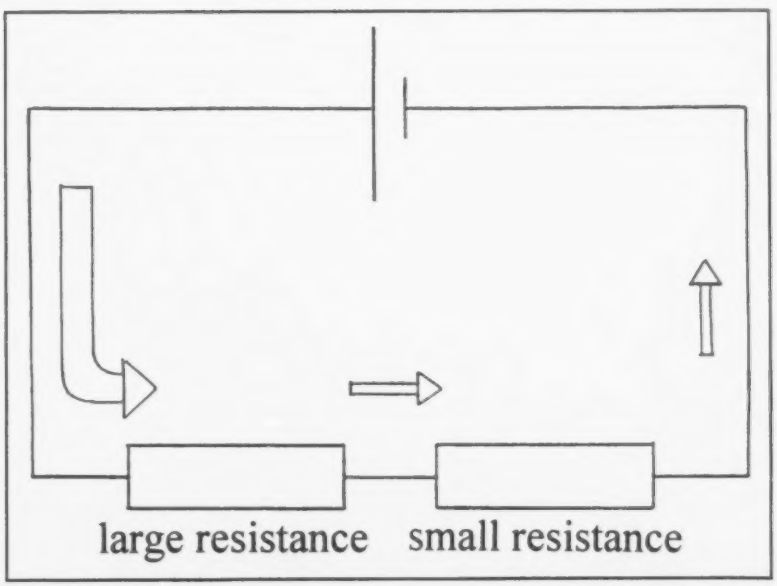


Figure 2

being reduced by blockages at each separate stage. In a parallel circuit (see Figure 2) one can say that the electricity prefers to pass through the path of least resistance, so most of it passes through the smaller resistor. One resistor may be very large (i.e. a large and serious blockage) but if the other resistance is small then electricity will get through easily.

Figure 3



In a simple series circuit (as in Figure 3), the electricity that can flow through the circuit is reduced when either resistance is increased. It only takes one resistor to be very large and very little electricity will flow. This behaviour is in keeping with our simplistic idea about electric flow.

In this case, however, the teacher knows that the voltage of the battery is now split into two parts, one part of the voltage of the battery across each resistor. There may therefore be problems if you start considering the 'electricity' in each resistor separately. An inspired student may ask, 'If one resistor was set, how would you choose the other so as to maximise the amount of electricity in it?'. The 'voltless' student may suggest reducing it so that there is as much electricity flowing through the circuit as possible. The teacher who knows about volts will be aware that this is only true if we are discussing the current rather than the power, since these two quantities are no longer simply proportional to each other. (In fact, to maximise the power, calculus shows that the two resistors should be the same.) Here then, is a fundamental limitation to 'voltless' electronic theory: it should not be used where discrete voltage drops are a central issue.

A 'Voltless' transistor circuit

Many important simple circuits, however, can be explained in terms of 'electricity' flowing from the battery and being reduced when it encounters a resistor, and by emphasising that this flow will diverge at a junction so that most of it flows down the route of least resistance. Take for example the simple transistor circuit and see if it can be described without making reference to voltage, current, amps, potential divide or power and, most especially, no numbers! We will simply talk about electricity and implicit in this term are the two concepts of power and current, neither of which will be referred to or differentiated between.

The classroom theory is that electricity tries to flow from the *positive* end of a battery to the *negative* (see Note 1). It can only do this in an *electric circuit. Resistors* contain *electrical resistance* which blocks the electricity and reduces the amount getting through. When the electricity has a choice of route, the larger part will prefer the route of least resistance. The *transistor* can be considered as a switch. Unlike a mechanical switch that allows

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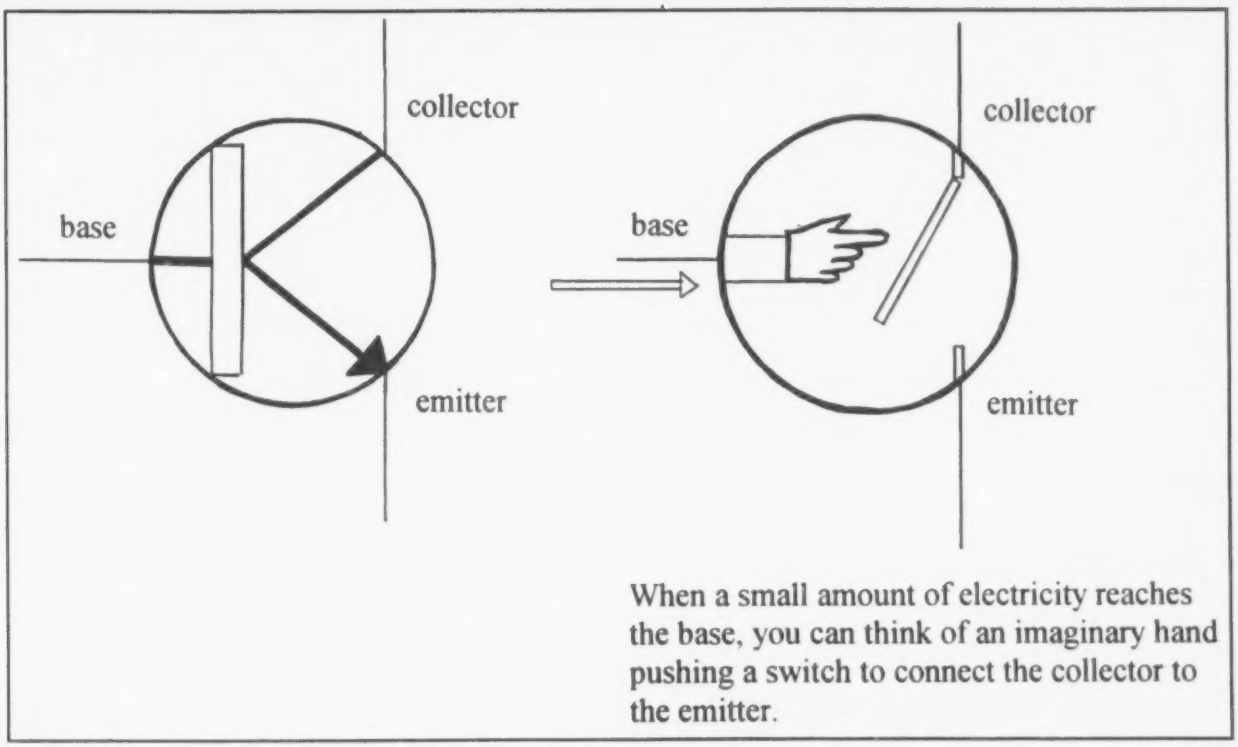

collector
base
emitter
collector
base
emitter
When a small amount of electricity reaches the base, you can think of an imaginary hand pushing a switch to connect the collector to the emitter.

Figure 4

electricity through when you turn it on with a finger, this electronic switch lets a large amount of electricity flow between the *collector* and the *emitter* when a small amount of electricity reaches the *base* (see Figure 4).

So, a transistor circuit can be considered as two separate circuits. The first provides an electronic signal to a switch which completes a second circuit.

Explanation of a light-detecting circuit

Electricity flows from the positive end of the battery through the LDR (light dependent resistor). If the LDR has a high resistance (i.e. it is dark) then the electricity is blocked there and nothing more happens (see Figure 5).

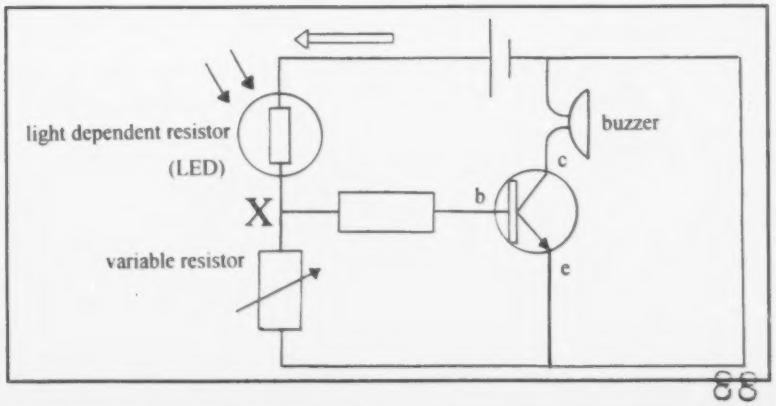
If the LDR has a low resistance (because there is some light) then electricity flows through it to junction X. It then has a choice. It can either go through the variable resistor OR go through the resistor to the base and switch the electronic switch connecting c and e. This completes the buzzer circuit. (So, for the circuit to turn the buzzer on in the light, the variable resistor must be turned up just high enough so that sufficient electricity prefers to go to the base and turn the transistor on.)

This explanation may throw up questions:

Q Why do you need the resistance of the resistor? Why not just connect the base straight to junction X?

A If there was no resistance at all then all the electricity going through the LDR would reach the base. Even the small amount of electricity that goes through the LDR in the dark would be sufficient to turn the transistor on, so the buzzer would be on all

Figure 5



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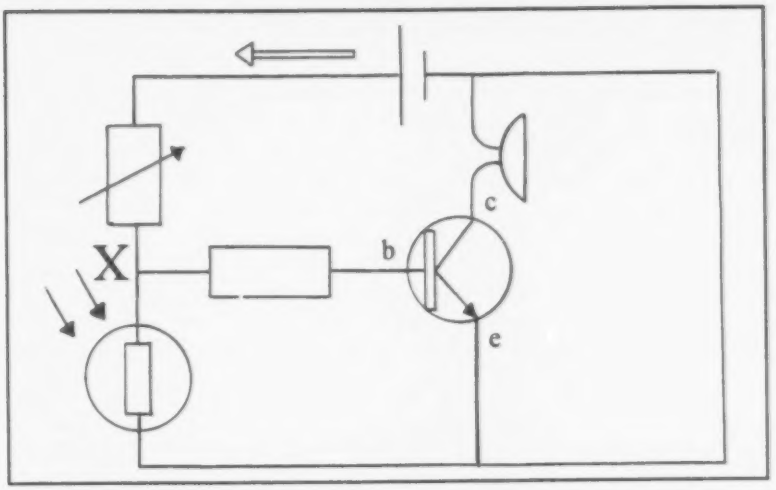

Figure 6

the time. Some of the electricity needs to be diverted away from the base to make the circuit *sensitive*.

Q Why do you need the variable resistor?

A Again, this would result in no choice at junction X, and even the small amount of electricity going through the LDR in the dark would turn on the transistor.

Explanation of a dark-detection circuit

The electricity flows from the positive end of the circuit and gets most through the variable resistor if it is turned down low (see Figure 6). It then has a choice. If it is light then the LDR resistance will be low, so most will flow through it and continue round to the negative terminal.

If it's dark, then the LDR resistance will be high and the electricity will be diverted through to the base in its attempt to find the easiest route to the negative terminal. This may, of course, switch on the transistor and sound the buzzer by connecting c and e and completing the buzzer circuit.

Q Why do we need the variable resistor?

A Whether sufficient electricity is reaching the base to switch it and connect c and e will depend on the amount of light but also on the setting of the variable resistor. So the variable resistor again sets the *sensitivity* of the circuit.

With this understanding of the simple transistor circuit the student is able to design a variety of sensing devices to detect light and dark, heat and cold (using a thermistor in place of the LDR) or wet and dry (using two wires in place of the LDR). Not only does this simple piece of theory help answer questions such as those above, it also allows the understanding and application of simple fault-finding procedures. Take, for example, the first light-detecting circuit: if the circuit doesn't work immediately then, in addition to checking the quality of soldering, some diagnostic checks can be made:

— Test the buzzer by touching the collector straight to the negative terminal. This gets rid of the transistor switch.

— Test the sensor by shorting its connections. If the switching circuit is working then this should feed the base with electricity and switch on the buzzer.

— Touch the negative end of the buzzer to the emitter. If the emitter is properly connected to the negative rail then this should sound the buzzer.

These are quite crude tests but they are a useful way of helping students to help themselves and at the same time gain a greater insight into the workings of the circuit. They also allow the teacher more time to teach by reducing time spent helping students diagnose faults.

Note 1: It is convenient in this case to talk about a positive flow of electricity flowing from the positive to the negative terminal. In reality, electricity is made up of negatively charged electrons travelling from the negative terminal to the positive, and science teachers often prefer this convention. There is no contradiction of course, since two negatives make a positive!

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A Systems Approach to Designing and Making in Electronics

Torben Steeg

Freelance Consultant in education and Honorary Research Fellow in the Department of Education at the University of Manchester

In the post-Dearing curriculum the place of electronics will be in Design and Technology. The challenge that this poses to students of D&T — and their teachers — is considerable. However, the potential electronics has for extending the range and quality of students' work perhaps makes the challenge one worth rising to — if an approach to the teaching of electronics can be established that brings its use as a 'medium' within the range of all of our students. The aim of this article is to show how the consistent use of a systems approach to the teaching of electronics can make both designing and making in electronics accessible to the majority of secondary students.

Background

A practical systems approach to electronics design had been established by the mid 1980s by a working group of the IEE. This group produced a specification for a set of electronic function, or systems electronics, boards which led to the development of commercial products aimed at the schools market. These included Alpha from Unilab and E&L boards from E&L Instruments.

Further support for a systems approach to teaching electronics in D&T was established when QuickTrack (printed circuit board (PCB) design software for the BBC Master computer) was published by NCET in 1990. This remarkably friendly (for a BBC) software provided support for a systems approach to making that was consistent with design work based on the commercial kits.

The driving force behind both of these developments was a desire to place designing and making in electronics within the grasp of all students (as opposed to the elite who were, perhaps, able to cope with O level or GCSE courses in Electronics and the associated mathematical and scientific understandings that these courses required), and also to mirror more closely the approach to electronics design taken by professional electronics engineers.

In the light of these developments, the fact that electronics has not been widely adopted in D&T departments across the country, nor across the ability range within most departments where support for some electronics remains, is surprising. I believe that two things have conspired to submerge these developments. The most significant of these was the publication of the National Curriculum Orders for Technology, which provided very little support for any departmental investment in electronics and none at all for a systems approach to electronics. That the Science Orders, in both incarnations, had a significant section on electronics, further absolved D&T departments from responsibility in this area. Meanwhile, on a completely different front, rapid (and generally welcome) developments in computer technology left the BBC Master looking both rather outdated and something of a niche computer. School investment in hardware and software tended to go to newer machines for which no equivalent to Quick-Track existed.

The upshot of these developments was to leave the teaching of electronics in the hands of science departments, with the focus much more on details of component function rather than on the use of electronics for a purpose.

New Developments

There are, now, a number of reasons for D&T departments to revive their interest in electronics and in a systems approach:

- The new, post-Dearing, National Curriculum has moved electronics entirely out of science and into D&T
- The focus of D&T project work has moved much more towards the designing and making of complete products that incorporate a range of technologies, of which electronics might be one. This means that students have a limited amount of time to study electronics, even in a 'full' course with electronics at its focus. The amount of detailed electronics that can be learnt is low yet the possible design applications are wide. A systems approach can meet these demands. The proposals for Technology recognise this and support a systems approach to the teaching of electronics.
- PCB design software that can be used to support a systems approach is finally appearing for modern computer platforms.

A Note on Systems vs Components

There has, at times, been a dichotomy drawn between a 'systems' approach and a 'components' approach to the teaching of electronics. A number of publications (the QuickTrack manual, for example, and NEMEC's *Science and Technology with*

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Electronics series, Unilab's Alpha Resource) have explored this debate; the main conclusion to be drawn is that the division is an artificial one. Any teaching of electronics will in some parts be system based and in others component based. The balance between the two will depend on the experience and sophistication of the students, a greater emphasis on systems being found in elementary courses with an increasing emphasis on component level design as the students progress and increase in their mathematical ability.

The rest of this article will give a brief overview of some teaching materials and approaches that can support a systems approach to designing and making within electronics. The needs of typical Key Stage 4 students will be kept in view, and much of what is said will be appropriate for students in Key Stage 3.

The process of designing and making electronic circuits is divided into three stages:

- Electronic design for all: systems boards in prototyping electronic solutions
- From prototype to PCB: a systems approach to PCB design
- A successful population strategy: systems in the support of making.

Electronic Design for All — systems boards in prototyping electronic solutions

Both Alpha and E&L boards can be used to prototype electronic circuits rapidly for the purposes of testing and refining design ideas. Though these two products use different approaches in their physical design, they provide broadly equivalent systems functions in most cases. The independent development of the two systems since the original IEE specification means that they do not entirely overlap and there is a greater range of functions available in Alpha.

Both products have associated publications (*The E&L File*, and *Alpha Resource*) that provide teachers and students with practical support. The latter is particularly comprehensive.

Signals

A central idea for students to have, if they are to progress in their understanding of the use of systems boards in electronic design, is that of the *signal*. An electronic circuit receives a signal from the physical world; this requires an input transducer (a sensor) to convert a physical signal into an electronic signal. This electronic signal is processed in some way, and the resulting (different) electronic signal is then usually communicated back to the physical world, this requiring an output transducer (an actuator) to convert it into a physical signal. This idea gives rise to a familiar figure where the arrows show the route of the signal into, through and out of the system (see Figure 1 below).

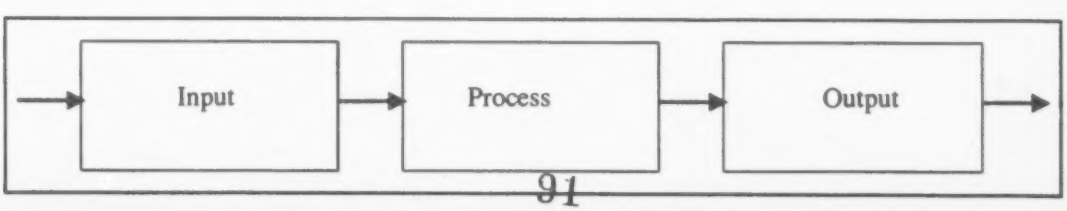
The hardware for both Alpha and E&L emphasises the route of the signal through a circuit and students' attention should be focused on this route. Such a focus on the signal allows the students' design questions to be at a level of function that is appropriate to their ability. Questions such as 'What kinds of physical signal are going into the circuit?' direct attention to the input sub-systems that are needed, and 'What needs to happen to the signal between the input and the output?' looks at the function of the various process sub-systems available.

Practical use of the kits

It needs to be noted that, though Figure 1 seems to suggest that an electronic circuit will have just three sub-systems in it, a practical implementation of any electronic circuit is likely to need five stages where each stage may require one or more sub-systems (see Figure 2).

Power supply boards are useful because, in addition to providing the correct voltage levels, they provide a degree of protection to the rest of the sub-systems at the inevitable moment

Figure 1



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Power supply	Input	Process	Driver	Output

Figure 2

when a student connects an inappropriate power source. A driver is usually required to boost the power of the signal from the process stage. In principle a driver should not change the size of the signal at all, it should just ensure that the output device has sufficient power — power that process boards usually cannot provide. However, a confusion in some sub-systems is that the division between 'process' and 'driver' can be blurred; some boards both process (change) the signal and drive (boost the power of) it as well. The distinction between process and driver needs to be made clear to students and the sub-systems that sit across the boundary should be pointed out.

In the initial stages of students' exposure to electronics it is helpful to present systems boards to them grouped in the categories shown in Figure 2, and to limit the number of choices in each category. This keeps to a reasonable level the number of new subsystems whose function students need to be familiar with, and the possible design options are manageable. The information that students then need so that they can engage in electronic design, relates to the effect of the various available sub-systems on the signal, the 'what it does' being of much more significance at this level than 'how it does it'. One level of progression can be the provision of a widening range of available sub-systems; the range of process sub-systems is particularly significant as the function of some sub-systems is much easier to understand than others.

A wide range of different circuits can be made with a quite limited range of subsystems, particularly once the context within which the circuit is embedded is taken into account; a circuit to provide a signal when a particular temperature is reached has myriad applications, although each application effectively leads to a different circuit since not only might the output devices differ but the temperature trigger point will also need to be appropriate to the context.

From Prototype to Printed Circuit Board — a systems approach to PCB design

The use of a systems approach can lead to a high-quality electronic design solution quite rapidly. If this prototype is the end point of students' electronic experience in D&T, as is the case in many schools, the experience is an impoverished one for a number of reasons:

- The need for efficient use of resources means that circuits need to be dismantled at the end of each teaching session and reassembled at the start of the next one; this is de-motivating and time consuming
- The resultant, rather unwieldy, circuit cannot be integrated with the other technologies that are being used in the product; thus the final product will be incomplete in an important way
- Students are deprived of insight into industrial practices relating to electronic circuit production and quality control
- Students do not gain increasing familiarity with the components that electronic circuits are made of in the context of their own designs; such familiarity is the first step in students' progression to understanding about components.

The reason that a 'prototype' made of sub-systems becomes the end point of students' work in electronics is easy to find; it is quite hard to move from this set of sub-systems to a reliable PCB mask because the following, difficult, steps need to be taken:

- Translation from the systems design into a circuit diagram
- Translation from the circuit diagram into a PCB mask
- Drawing out of a high-quality mask.

Each of these steps requires the use of process skills that are beyond the capabilities of a wide range of students. The complete process is rigorous and time consuming even for those experienced in electronic design.

However, the process is also mechanical and thus an ideal candidate for solution through computer power. Thus electronics provides a context where CAD can allow students to achieve that which would be impossible for them without it.

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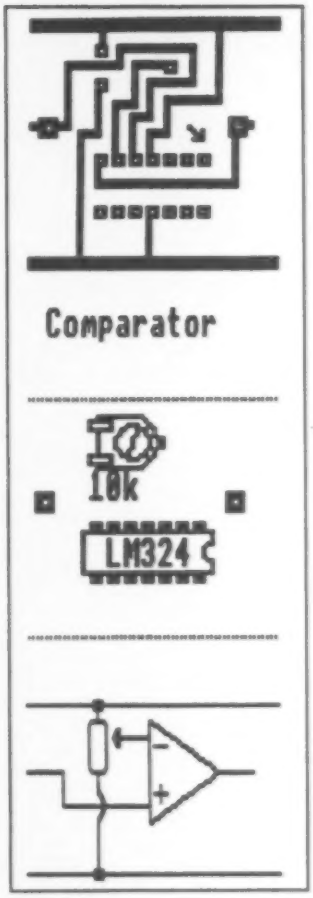

Figure 3

QuickTrack

Although technologically outdated, QuickTrack is sophisticated and well thought through in terms of its educational objectives. Its features are worth detailing in that they provide a standard against which to judge modern PCB design packages:

- It is a general schematic (circuit diagram drawing) and PCB design package, so the needs of the most able student are catered for.
- It incorporates the ability to save files in a library structure. These files can be joined together on screen to produce designs quickly and in a way that is accessible to a wide range of student abilities.
- It comes with an extensive library of files that are electronically isomorphic to the sub-systems of the Alpha and E&L kits. Each of these sub-system files places on the screen a PCB mask for the sub-system, its name, a component layout and the schematic diagram. Figure 3 shows the file for a 'comparator' sub-system.
- Tools are included to manipulate these library blocks — for instance the PCB mask for a light-sensing input sub-system can be inverted around a horizontal axis to choose between light and dark sensitivity.
- All the provided library files have been extensively tested with each other to ensure functional and electronic compatibility; the resulting PCB masks are therefore electronically robust and reliable.
- Each library sub-system is documented for students (in the manual) with information on its function, the components needed, mounting information and procedures for testing and fault finding (see Figure 4).
- The total number of components that a department needs to stock to make any combination of the sub-systems is 50 — an important consideration in the light of the DATA survey on capitation allowances in D&T departments
- There is a link to a spreadsheet to enable students to produce a component shopping list from their PCB design
- The accompanying manual is an excellent, and practical, support tool for classroom work for both students and their teachers.

In my view the software is probably worth buying for the manual alone since its cost is so low. If a D&T department could assemble the BBC Masters, it would also provide a perfectly adequate base for the kind of work described in this article.

Software for modern computer platforms

The reality for most D&T departments is that they need software for the newer computer platforms. However, PCB software with the features offered by QuickTrack has been relatively slow to hit the market. It seems to me that the critical features that such software must provide are:

- use of the machine's WIMP environment. Given the small amount of time time that each student will spend with the software, the time taken to learn to use it must be minimal. This reduction in learning (and remembering) time is the great strength of WIMP environments in educational situations. The development of (reasonably costed) PCB software has been particularly slow in the IBM-compatible Windows environment.
- support for library files that can be merged on the screen. It is this feature that allows the systems approach advocated here to be pursued; much, otherwise very useful, software is not able to do this.

Other features of QuickTrack can be added if these two features are present. In particular, I believe that there are significant advantages to incorporating the library files used in QuickTrack since they are proven and bring with them such features as the limited component set. Agreement between NCET, which has a degree of ownership over the copyright of these files, and software providers needs to be secured to allow this to happen.

It is worrying that there are a number of groups of teachers around the country who, through their commitment to the approach advocated here, are working to create their own sets of masks for each sub-system. Apart from the time and energy that this consumes, the concern is that, without the testing and design time (and cost) that were invested in the QuickTrack masks, the resulting masks may well end up being far less robust. The end result of this could be circuits that do not work reliably, or at all, and thus reduce students' often already

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weak confidence in their ability to 'do' electronics.

The software that currently seems to me to be the best for each platform is:

Archimedes: Fast Trax from Techsoft
IBM compatibles: Quickroute 3, from Power Ware or Economatics

(At the time of writing I have not been able to find PCB software for Macintosh computers that meets the second criterion above. I would be very grateful to hear of such software if it exists.)

This is not to say that there is no other software that is equally suitable These are merely those that I have found that meet the above criteria, are reasonably priced and are, in my clearly subjective view, the easiest for students to use. Of the two, Fast Trax has the friendlier user interface, and can also directly drive a Roland CAMM2 to engrave the PCB mask onto copper-clad board. If a D&T department already has a CAMM2 this is a cleaner and cheaper method of producing PCBs than chemical etching and a good (if non-standard) demonstration of the power of CAD/CAM.

However, most D&T departments won't have the luxury of choosing between platforms.

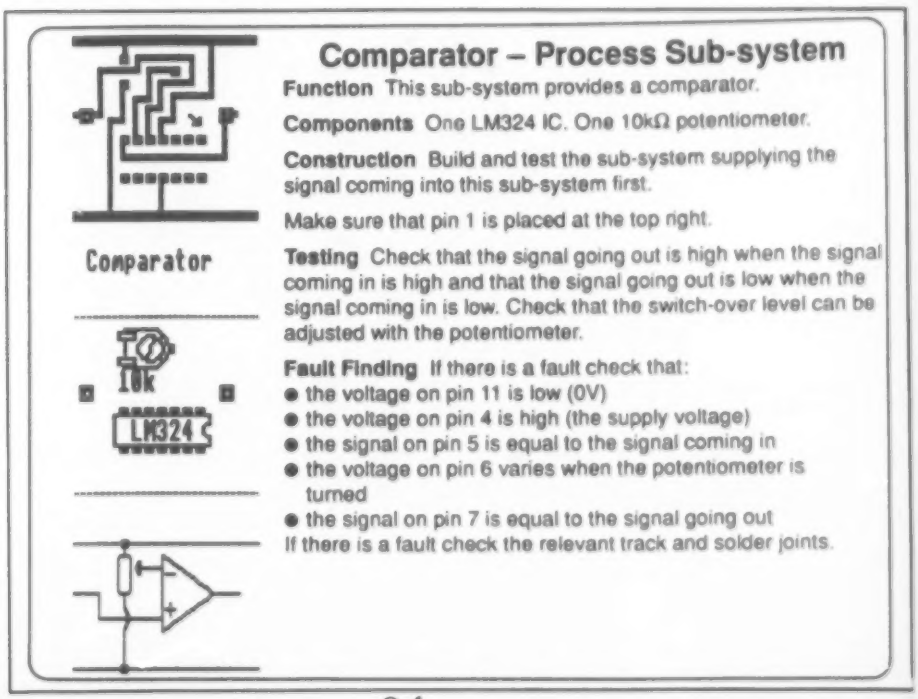
Neither of these at present has full sets of the sub-systems files needed, but discussion is going on with the authors and NCET to have these files incorporated.

A Successful Population Strategy — systems in the support of making

An experience familiar to most teachers who have been involved in making in electronics is that of being under siege as pupils approach with PCBs that they have populated with components and which do not 'work'. To students the reasons why their board does not work is usually entirely mysterious, as is the process by which their teacher (sometimes) provides the magical cure. To the teacher the reasons why a board does not work may be equally mysterious, and, even if it is not, the cause will usually require some concentrated detective work. During this time the rest of the class is unattended and queues can build rapidly. All of this is not conducive to good order in a classroom, is de-motivating for the student and only serves to reinforce the student's notion that electronics is 'hard'.

The solution to this problem lies in pushing responsibility for quality control in making back onto the students. A systems approach to the population of a board with components and to the testing of the board as it is being populated, can allow students to take on this responsibility in a way that is matched

Figure 4


Comparator – Process Sub-system
Function This sub-system provides a comparator.
Components One LM324 IC. One 10kΩ potentiometer.
Construction Build and test the sub-system supplying the signal coming into this sub-system first.
Make sure that pin 1 is placed at the top right.
Testing Check that the signal going out is high when the signal coming in is high and that the signal going out is low when the signal coming in is low. Check that the switch-over level can be adjusted with the potentiometer.
Fault Finding If there is a fault check that:
● the voltage on pin 11 is low (0V)
● the voltage on pin 4 is high (the supply voltage)
● the signal on pin 5 is equal to the signal coming in
● the voltage on pin 6 varies when the potentiometer is turned
● the signal on pin 7 is equal to the signal going out
If there is a fault check the relevant track and solder joints.
Comparator
10k
LM324

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realistically to their capability and experience of electronics. A suggested procedure is:

- Populate the sub-systems one at a time, starting from the power supply and working from input stage to output. Each sub-system will only have a small handful of components associated with it, so each stage of the making becomes manageable even with relatively complex circuits. Appropriate data sheets can show the components required and their location and orientation on the PCB (see Figure 4).
- After each sub-system is populated it should be tested by checking that the signal emerging from the sub-system is as expected. Data sheets can support this testing and outline the procedures to be followed if a fault is found; those provided with QuickTrack are good examples of what is possible.
- Progress from one sub-system to the next should only occur when the current one is working satisfactorily.

Thus at each stage the checks needed to ensure correct functioning are limited and there are only the newly soldered components to check if a fault is discovered.

Advantages of this process are that, as well as saving the teacher from the cameo described above, the student gains experience of electronic testing and fault-tracing procedures in a systematic environment. This experience builds useful practical skills in students, enhances their electronic understanding and de-mystifies electronics by bringing it within their control.

In trials of this approach it has been reported by teachers that for the first time in their experience they were getting up to 100% success rates in classes who were being introduced to PCB making for the first time.

Summary

The approach outlined has been based on the consistent use of just a few basic ideas:

- The use of electronic sub-systems as the fundamental units in circuit design and making
- Knowledge about a sub-system being limited to its function ('what' rather than 'how') at least in introductory work, a feature of progression being a growing understanding of the function of a range of components
- A focus on the path of a signal through a circuit so that the knowledge required about a sub-system relates to what it does to the signal.

A further benefit of this approach is that it contains a degree of future proofing in the face of the march of technology; the functions that are required of a circuit are likely to remain the same, the way that a function is implemented may well change. Students' primary need at 16+ is to understand the scope of electronics rather than the detail. Perhaps too, a systems approach could free us from the obsession that examination boards have had with such outdated components as the 741 op-amp or the 555 timer.

It is to be hoped that curriculum materials developed to support the new D&T curriculum will support a systems approach to electronics teaching and thus make electronics accessible to all students.

References and further reading

NEMEC, *Science and Technology with Electronics series*: Module 3 — Learning Electronics through Systems and Module 6 — Developing Systems Electronics

NEMEC, *An Introduction to the systems approach using Alpha* (a set of student worksheets with teacher support)

NCET, *Quick Track*, 1990

Unilab, *Alpha Resource*

Economatics, *The E&L File*

Pilliner and Snashall, *Systems Electronics: A course for GCSE and Practical Systems Electronics*, Macmillan

IEE, *Electronics Education* journal

Resources

Alpha systems boards are available from Unilab

E&L systems boards are available from E&L or Economatics

Quick Track for BBC Master is available from NCET

Fast Trax for Archimedes is available from Techsoft

Quickroute for IBM-compatible (with Windows) is available from Power Ware or Economatics.

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Designing Systems from the Inside

Mike Bostock

Mike Bostock, who was co-ordinator of the project which gave rise to the computer control program Logicator, describes why it was developed and how it can contribute to systems work within technology

Logicator was an idea that came to light nearly ten years ago. In those days, before the National Curriculum, there were pockets of educationists who recognised that computers had much to contribute to the subject of technology in schools and who worked together to develop ways to make it possible to bring more IT practices into technology departments. It was recognised that the sort of technology that pupils would increasingly be meeting all around them — at the cashpoint, point-of-sale systems, with video recorders and word processors — was a different technology to that which they met in a department called 'CDT'. In there, technology was largely making things out of wood, holding a saw straight and getting a good finish — in essence, craftsmanship. This was important, but it was perceived that designing and making needed to be taught in the context of evolving technologies in the real world.

What these enthusiasts recognised was the importance of *systems* as a subject of study and something worthy of designing and making. This was always a problematic topic because systems were something that had to be programmed, and this was the blackest of arts, only understood by the strangest of people (usually bearded) who called themselves teachers of Computer Studies. Yet the goal was irresistible because systems were becoming more significant than artefacts and the essentially craft-based activities associated with their creation. Designing and making systems would offer richness and challenge to the brightest student, providing scope for activities that could shape tomorrow's engineers from the moment they realised their intellectual and practical skills could unite in the achievement of making a system. Even if it were just a programmed buggy, one could sense this to be the beginning of something relevant and something distinctly important to the nation.

What is a system?

A system is an artefact that has a function, often electro-mechanical, sometimes purely electronic. It can carry out tasks by referring to a set of rules, or conditional sequences, that are held inside its memory. To make a system one has to build two things: the physical device and the program that controls its function. They are both as products, although conventionally the physical product has been more highly valued as a product over the computer program. The reason for this is that the computer program is usually unintelligible. One can only deduce its effectiveness by watching the system work. What was required was a way to make programs that could be seen and understood by humans as well as by machines.

Much work was done in the 1980s to try to make it possible for ordinary souls to write control programs, or *structures built from information*. There was Control BASIC, a way to insert control keywords into the BASIC language. However, this was still programming and as anyone knows who has tried it, there must be a better way of doing something this simple and not be humiliated so comprehensively by a smug machine telling you about a syntax error on line 20 but not telling you any way of solving it.

The project of that time was the development of a diagrammatic control program called Bricks. This was a brave attempt to draw blocks on the screen into which there were short series of keywords that turned on motors and detected the state of sensors. Building the control program involved stacking the bricks together. This approach was hampered by the lack of memory on the BBC micro but otherwise pointed the way forward.

With windowing systems and increased memory in modern machines, it has become possible to rethink the ideas of visual programming languages as applied to developing control programs or *system algorithms*. The idea was born of a friendly program that would let you draw and test logical structures without having to write low-level code. The medium of the flowchart had to be the right one to use because people who are not programmers use flowcharts to explain an operation that is dynamic or conditional. For if one is going to get involved with creating instructions that are not predictable but depend on conditions that constantly vary, then the flowchart is one of the best ways to represent it, and to explain it to someone else.

Where Logicator came in

Logicator is both a drawing program and a programming medium. Its drawing functions, including 'drag and drop' and 'block move' are easily recognised by anyone who has used a simple drawing program. But underneath the surface of the drawing the program creates fast, computer-readable code that can control

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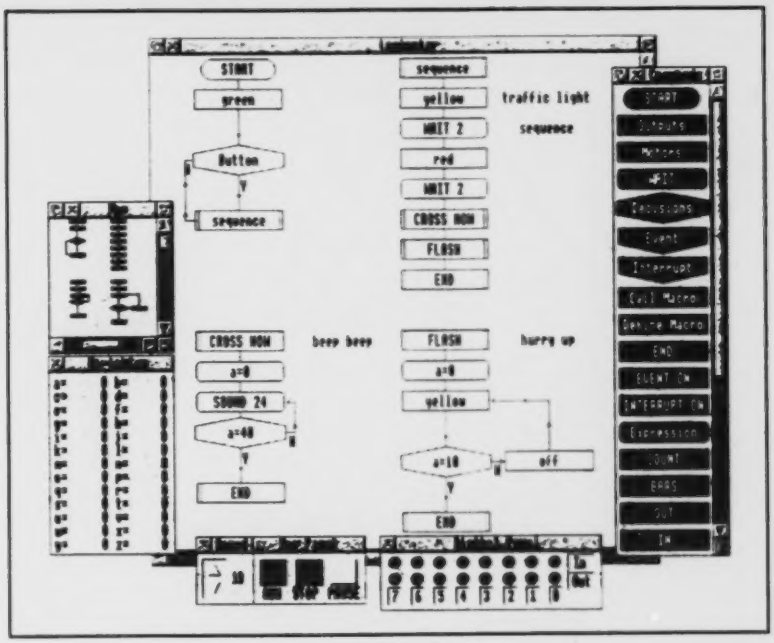


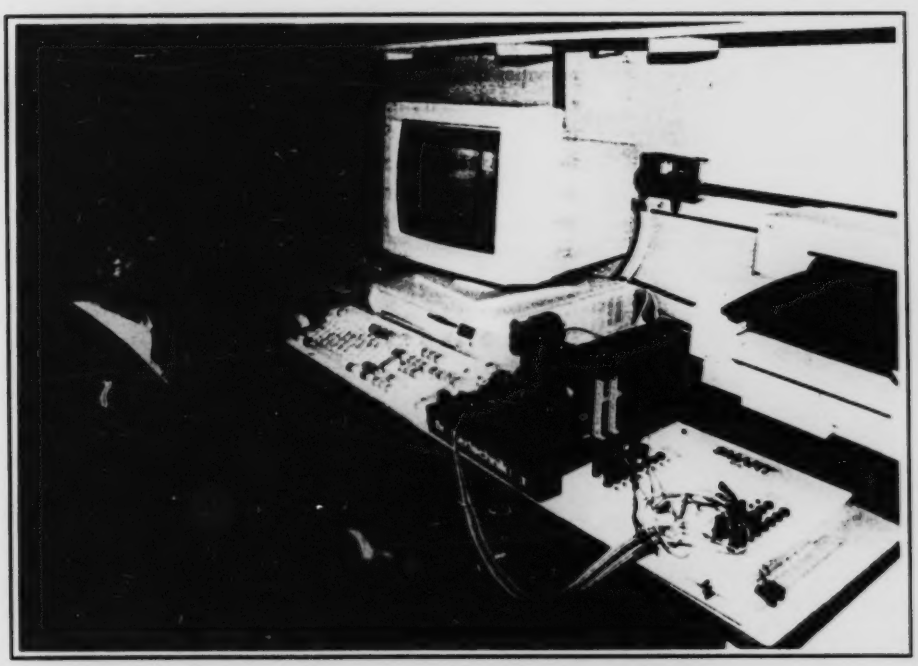
Flowchart of pelican crossing

motors, lights and sensors and operate the most demanding system, or model of a system. The flowchart can then be run as if it were a computer program by pressing a Start button. Program flow is shown by following a highlighter around the flowchart. Logical problems can be deduced from observing program flow and easily corrected by redrawing the offending section. Because the algorithm is a physical drawing rather than a list of commands whose function may not be obvious, it is now possible to get both teacher and learner involved in discussing the design efficiency of a particular flowchart.

Well, that's the theory. The acid test of this technique is 'does it encourage progression in systems work?'. This is an important question because currently many would feel that there are few examples of progression to be seen in schools within the medium of computer control. The best examples of computer control work in primary schools produce some nice models and about six Logo-style control procedures. The best examples in secondary schools produce . . .well, it would be quite hard to find more advanced examples than this.

The reason for this has been referred to in a previous article, but in essence the nub of the problem is that control programs like BASIC tend to be one-dimensional, like a list. Decision-making control programs that use several or maybe multiple, sensors can be more efficiently designed and communicated in the two-dimensional world of the flowchart because one can design the algorithm sideways as well as up and down.

Mike Pooley leads a team of staff who have developed a control technology room in the technology department at The Hedley Walter School in Brentwood, Essex. The department uses Logicator running with Acorn RISC PCs in conjunction with Smart Box interfaces and system models that include an automatic door,



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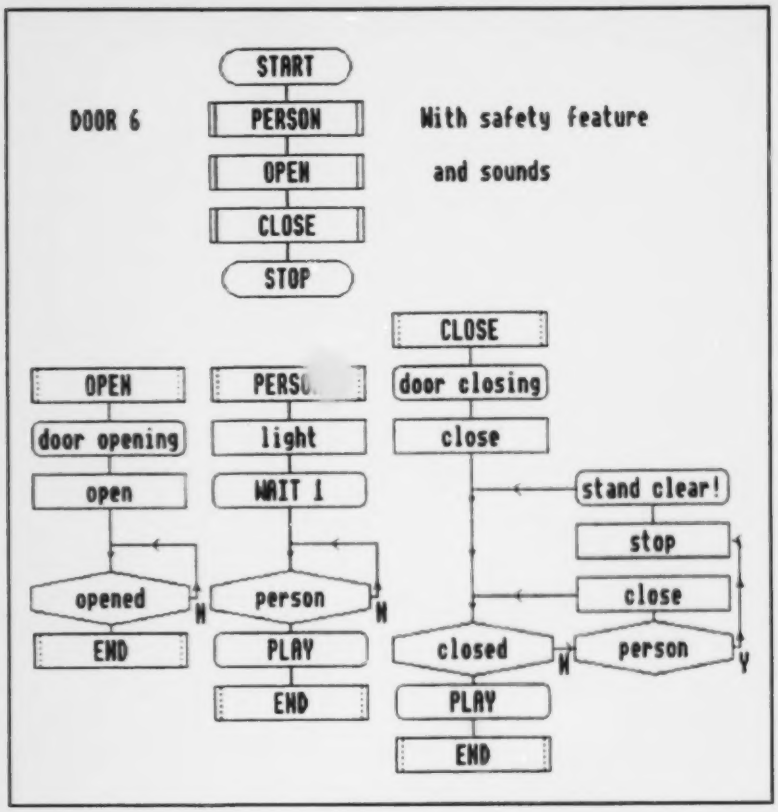
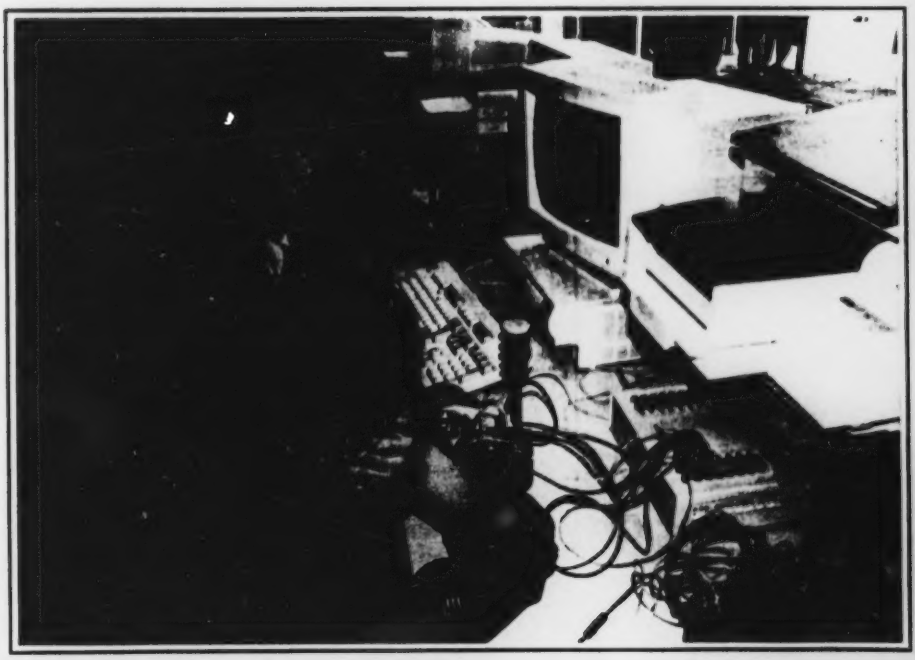


Above: Flowsheet for an automatic sliding door: the door is activated when a light beam is broken and includes a safety feature on closing; it can also play sampled sounds such as 'Stand clear!'

a sensing buggy and a card reader. The system has been chosen because the school is committed to up-to-date practices and techniques that are close to those in industry and manufacturing. This has involved a heavy investment in IT and control equipment but enables the department to teach designing and making using a range of materials and to place IT capability within a relevant context.

Mike now uses Logicator across all the year groups, starting with Year 7: 'By Key Stage 4 we are hoping that students will be able to design and build systems from different materials and link the use of Logicator with other work in technology such as electronics'. He also hopes that as pupils develop capability in all areas of the subject they will be able to design and build programmed systems as part of the complete design cycle. In effect pupils are designing systems from the inside: by putting the functionality of the system first and treating it as a design exercise where the medium is the flowchart. Logicator is an idea that has taken some time to arrive but now looks set to make an important contribution to promoting progressive systems work in technology.

Opposite and right: pupils from Hedley Walter School tackling control



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Using The Design Processor

Geoff Howard

Technology Adviser, North Yorkshire

The Design Processor is a suite of programs for the Archimedes, developed by NAAIDT and Oak Solutions to support D&T; Geoff Howard, who was closely involved in its development, describes some of its applications

The Design Processor sprang originally from the combined musings of members of the East Midlands and Yorkshire regional group of NAAIDT: how useful it would be if there were some kind of management program which presented the same user interface to pupils and yet allowed them to use different software packages and to transfer work from one to another. What was needed was a design package for pupils which would integrate information for design in the same way as desktop publishing does for words and pictures.

At its simplest, The Design Processor enables pupils to access database files covering packaging, kitchen design, food and electronics, edit them, join them together, manipulate them and even translate from one format to another — 2-D to 3-D kitchen design, for example, or system block diagram to schematic to finished PCB layout. The database is linked to a suite of 11 RISCOS applications, including some well known CAD and D&T software: WorraCAD, Oak PCB, Genesis and Euclid, for example.

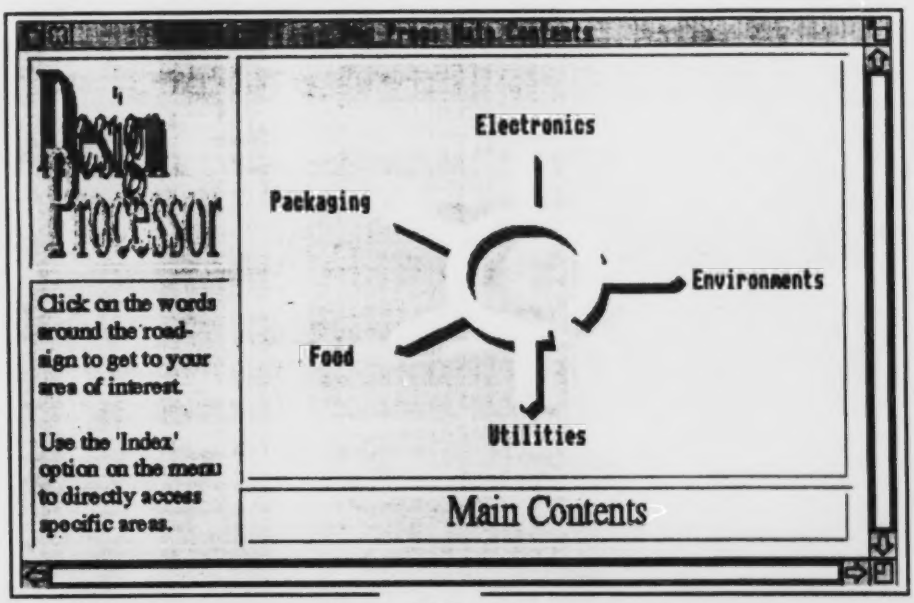
What The Design Processor offers

There are three distinct layers of entry to enable maximum accessibility by pupils. At the heart of the program is the large database which informs pupils about components and processes and provides a rich source of pre-drawn files which give pupils a flying start in their own designs. All database files can be fully edited and transferred to other RISCOS applications. Using Draw, for example, pupils can produce their own designs by adapting and adding a file from the database. At the third level, complete design projects are included, also fully editable, which enable pupils as young as Year 7 to achieve success from otherwise complex CAD packages.

A built-in Logic Simulator matches the original concept very closely: logic circuits are built on screen using the mouse to place icons representing logic gates. The database can be interrogated for information on each item and once the symbols are linked together using a simple rubber banding technique, the circuit can be operated on screen to test its effectiveness. It is hoped that further development will enable the screen circuit to respond to inputs and control outputs via the printer and/or user ports — making design and make activities almost simultaneous!

The current database contains an impressive library of 'objects', and by simply dragging an icon of the object into the screen application, it is displayed automatically in the appropriate form. Once objects have been loaded into an application (or editor), they can be modified, rearranged or added to as required. At any time pupils can interrogate the database to find out more about the objects being used, or to seek information on related topics — how to design a kitchen layout, for example.

A range of tools are available which allow new parts to be created or suitable materials to be chosen, or, for example, to calculate an



The Design Processor menu screen

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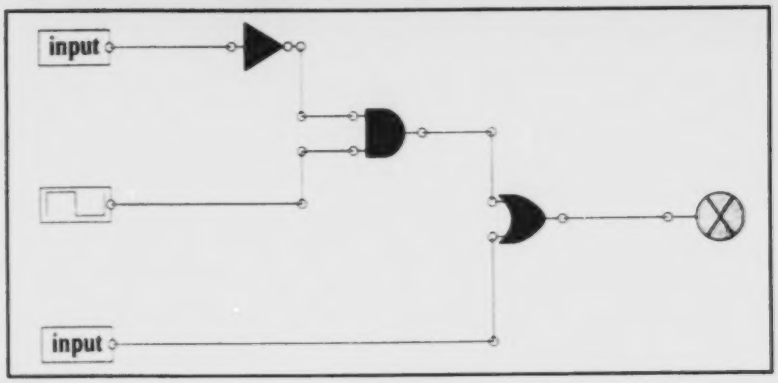
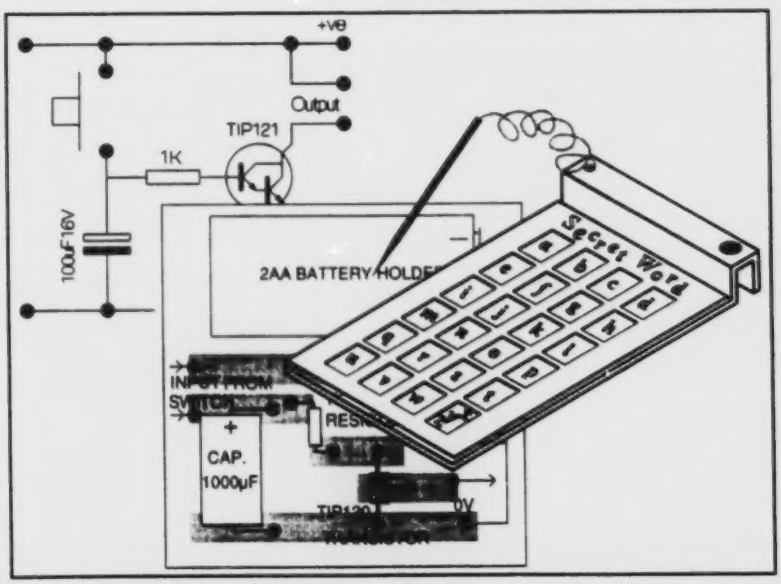


Circuit design using ready-made icons

appropriate resistor value. The ability to use additional tools such as nutrition analysers, calendar and bar-code generators would be a valuable extra feature, and work is continuing on developing this capacity.

The package also contains Draw Print and Draw Plot, to enable a variety of printed outputs. Draw Print links with the printer driver to enable users to scale and preview their work and, most usefully, to enable the printing of extra-large images which can be joined by tiling; full-size patterns for clothing, for example, can easily be printed out like this. Draw Plot enables the user to print out anything in a Draw File, including outline fonts and sprites, and output not only to printers and plotters but to cutters and engravers too.

Designing a quiz-card guessing game



Using The Design Processor in the Classroom

But how to use this wealth of resources in a D&T scheme of work? Design and technology is fundamentally about providing children with a personal experience of designing and making high-quality products which can be tested in use. IT widens the range of tools and equipment available to children, and through its integrated system, The Design Processor gives children access to a broader range of IT applications.

Most of The Design Processor's applications can simply be run as content-free CAD software if required, but many pupils find it helpful to load pre-drawn objects to get them started.

Year 7

A popular project with Year 7 pupils is the designing and making of simple guessing games or quiz cards. Many now use copper tape to produce the circuits and a number of commercially available materials exist to support this theme. Using The Design Processor, pupils can retrieve suitable circuits, interrogate the database to find out about them and adapt them using Draw. The print-out (including artwork) of the finished design can be stuck onto thin card and laminated using the usual school equipment. Alternatively, they could lightly spray some sheets of OHT film with adhesive and sandwich the print-out between them.

If this project were to be done as an Enterprise-type activity then advertising materials based on the original artwork could also be produced in Draw and printed out at full poster size using Draw Print — and be a useful back-up for the next school fair!

Year 8

Some Year 8 pupils have used The Design Processor more directly, with the Project route. They retrieved the design of a simple Zoetrope from a database file and modified it to fit their own designs. The net of the design was then plotted directly onto card using Draw Plot. The teacher had already provided a pro forma to help them design their own animated sequences for homework, so the Zoetropes could be spun by hand to test them. Animations could also have been produced using Draw or programs such as Tween.

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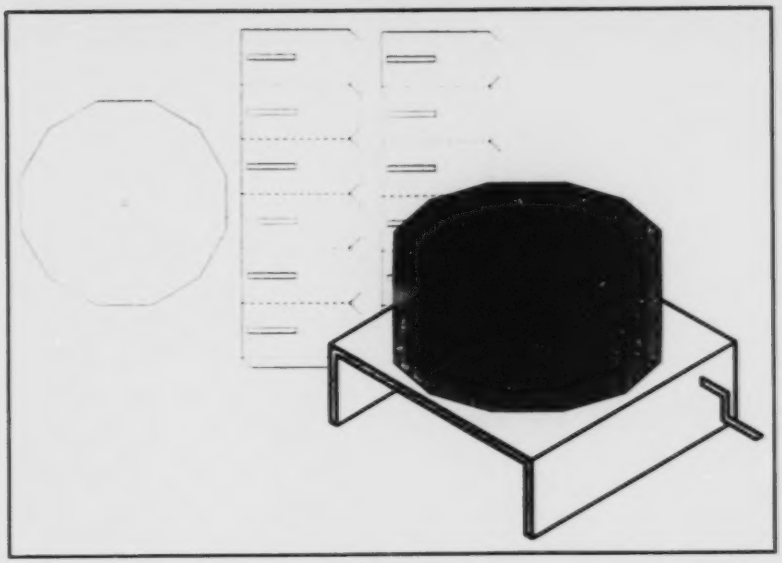


How to build a Zoetrope

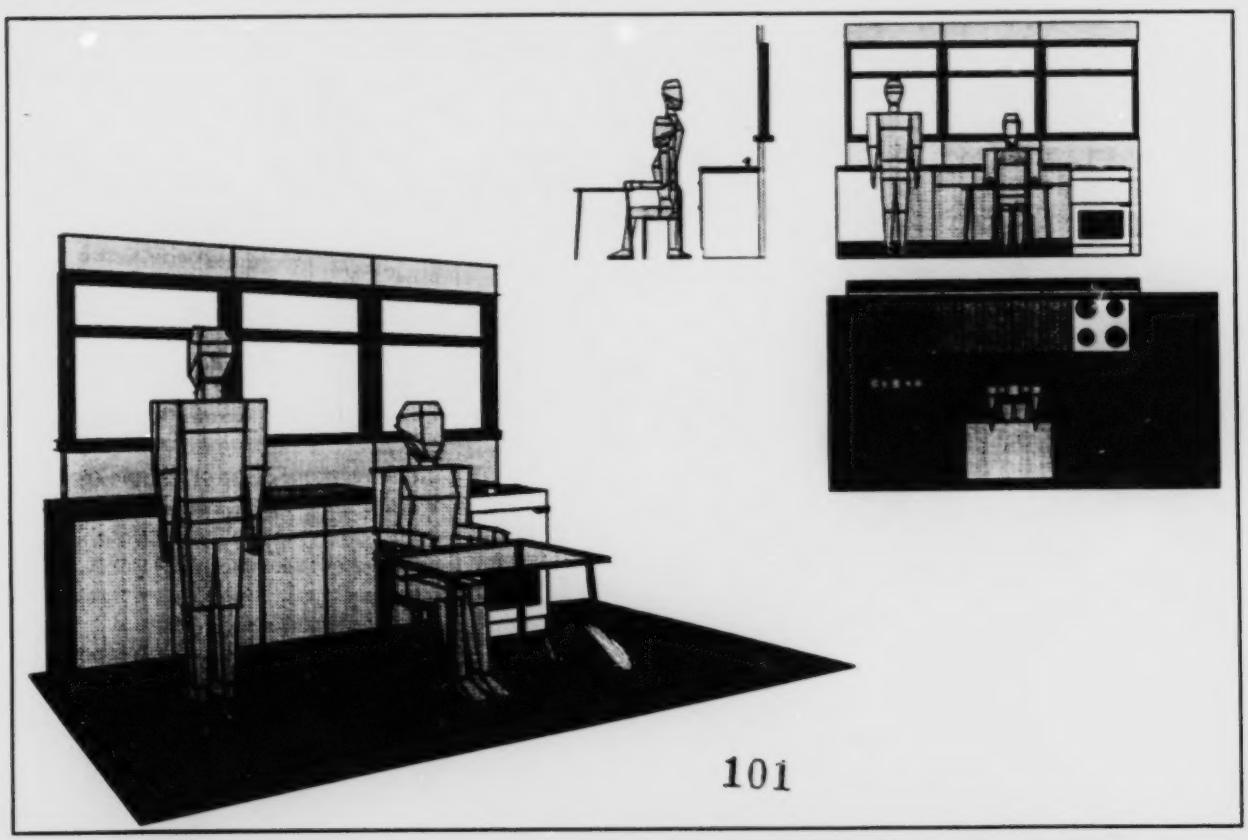
Year 9

Year 9 pupils have used the software to help them design a cereal packet. Having opened up various commercial packets and noted the nets used, they then used The Design Processor to help design a new package. They have also extended the work by designing and printing out some cut-out toys and games to go on the back of the pack, using WorraCAD.

Building on this experience, they then used one of The Design Processor's many nets as a starting point for one of the optional SATs. The Handled Box, for example, could easily be adapted to suit the requirements for a sports shoe manufacturer and the Fast Food Carton could form the basis of a container for use during plays and concerts. Using PDT View (a parametric drawing tool), the sizes would be altered and then the net could be transferred to Draw to be further modified or for graphics to be added. The finished net could be plotted out full size on card, and high-quality colour print-outs made of the labels.

During the following lessons they designed and made bases for the Zoetropes out of sheet aluminium or acrylic and included a hand crank to turn the completed device. The final isometric drawings could be produced using Draw using elements captured from Design Processor, or WorraCAD be used to produce dimensioned orthographic diagrams if they were needed.

From 2D to 3D in kitchen design



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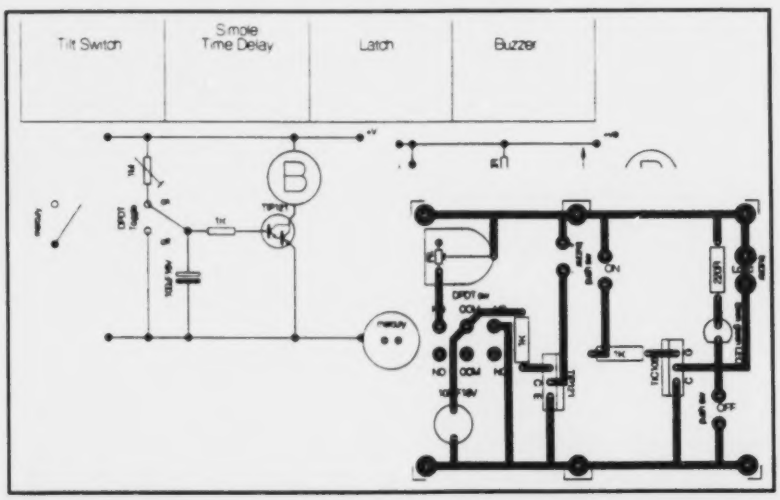
Years 10 and 11

As part of the Year 10 common core for technology, pupils might explore the use of IT as a modelling tool by creating a design for their own kitchen at home. The Design Processor provides standard kitchen units from its database which can be positioned on a WorraCAD scale drawing of their own floor plan, and then translated into 3D. Plans can also be viewed from different positions and under different lighting conditions, and even 'film' produced so the viewer can 'fly' through the completed design.

Students taking the Graphics extension are able to use this to aid their visualisation and to print out different projections including isometric, orthographic and perspective. The print-outs are available both in wire frame and solid and could provide raw material on which pupils can develop their rendering skills.

Using the same intuitive techniques, pupils doing the Food extension can explore the database to discover the effects of a range of menus which might be offered to specific people with particular dietary needs. The packaging section helps all who wish to design and made products in any of the design and technology materials.

Pupils have also used The Design Processor as a logic simulator to try out ideas and then used electronic systems kits to model a working circuit. After adjustments and experimentation with the hardware, they selected and adapted suitable PCB files, interrogated a database to find out more about them, edited them and printed them out. They were then able to photocopy their designs onto OHT film to produce a cell for photo-etching.



From system diagram through circuit diagram to PCB layout

The Future

The future of technology continues to unfold, but is likely that there will be greater use of electronics, plastics, white metals, textiles, manufactured boards and card to generate more batch-produced items or production prototypes as an enterprise activity or a direct consequence of a link with local industry.

At Key Stage 4, we envisage that food will continue as an important extension material and that it will still be essential to develop a high degree of designing and making skills in construction materials during the years up to Key Stage 4 when they will be put to good use assembling, fitting and finishing more sophisticated products.

In North Yorkshire we are keen to promote the use of IT where the computer neither dominates nor detracts from the essential purpose of designing and making but enhances it by empowering pupils and motivating them to make high-quality outcomes — often comparable with commercially available products!

We have advocated that:

— software be designed to be used intuitively

— applications are flexible in that they are not tied to a single peripheral

— applications are compatible in that they accommodate file exchanges between different types of computer.

The Design Processor already goes much of the way towards this and the Archimedes enables files to be saved directly in MS-DOS format. Taking the pupil's own floppy disc to be the 'workpiece', an analogy would be that pupils are able to use a range of machine tools and move the workpiece from lathe to drill to milling machine, for example, to complete a task — so why not a range of computers?

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Is design and technology education still interesting to our students?

A shortened version of a paper presented to the WOCATE International Conference, Banska Bystrica, Slovak Republic by John Eggleston, Professor of Education, University of Warwick. It will be published in full in 1995 in Blandow, D. (ed.) Innovative Processes for Human Resource Development and Small Scale Industries, *Berlin: Springer.*

I begin with three propositions, all of which seem self-evident:

1. Every individual wants more of the products of technology for their personal satisfaction, security, comfort, leisure and entertainment. The goods that consumers in every town and city desire are remarkably similar.
2. Every society and every government wants more technology education because it is seen to be the key to a developed economy and to growth in national income.
3. In consequence every education system is trying to develop technology education from the early years through to higher and post graduate education for boys and girls.

So why isn't it working? Why are there empty places in most technology degree courses in most countries? Why are many children switching out of technology in many schools and switching into subjects they find more attractive? In France the under-use and low capability of the university and technology institutes (IUTs) has led to major, even desperate, attempts by Francois Fillons, the higher education minister, to enhance their attractiveness.

One of our most cherished beliefs is that almost all students enjoy technology, eagerly await technology sessions and work enthusiastically therein.

In my work I visit many technology classes in many schools. Many projects are good but many are uninteresting and only modest in their results. I watch the faces of the students, many are involved but many more are dead. Alas, it is the same in science, maths and most other subjects. But why is it so in technology, I ask?

Kimbell of Goldsmiths' College, London (1994) has explored the matter. In a paper yet to be published he has identified three categories of involvement in technology:

Motoring (active learning)
Poddling (non-committed learning)
Static (inactive).

In the best lessons motoring was dominant for a maximum of 30% of the time. In most, poddling was the norm — an average of 75%. In many there was a disturbing amount of static behaviour.

In our search for answers let us be clear from the outset that human capability in technology, as in most other areas of knowledge, is for all practical purposes, unlimited. I can give many examples. When I have the tyres changed on my car the young worker at the tyre depot has no pretensions about being a technologist. His school record in technology was minimal, but with the aid of his pocket calculator and reference books, he can work out the specific requirements for the tyres I need. He can deduct the discounts, the special offer terms and the association membership concession, add on the tax and get the price right in seconds. He can operate the technology to fit and service the tyres with total reliability — also with impressive speed.

Young people who appear to have little capability in school technology have amazing ability to tune motor cars and motorbikes and know exactly how to enhance performance. They are able to develop hi-fi systems, using sophisticated science and technology capability.

One of the most exciting things in my career is to be Chairman of the Judges of the Young Electronic Designer Competition, a major national competition in Britain, sponsored by the Texas Instruments and Cable and Wireless companies. Entries come from children all over Britain, and the candidates' capability to devise useful, practical electronic devices is breathtaking. What is so astonishing is how few of the entries are coming through the schools. Most of the candidates learn about the competition through the electronic magazines and the components manufacturers' bulletins. We invite their teachers along to the finals and candidates often astonish their teachers by what they have been able to achieve. A very common remark from teachers is, 'I never knew that boy or that girl had the capability to do this'. Children have a secret world of achievement and capability that we as teachers very frequently do not recognise. Let me emphasise that I am talking about girls as well as boys: many of the successful candidates in the Young Electronic Designers competition, and in many similar competitions, are girls.

What can we do about it? We have the need and the human potential, why can't we get two things together? I think there are three areas to which we have to attend. They are ones that we are all very familiar with — teachers, industry and students. Those are the three raw materials with which we have to work.

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The Role of Teachers

Let us look at the teachers first. We have a major problem in many, many countries. First of all there is difficulty in getting able students into teacher training courses for technology. As Cotton (1995) confirms: 'In many countries the most able students are tracked into pre-science and other 'high status' subjects and discouraged from technology and 'practical' studies.' That means that there is a relative shortage of graduates, and particularly good graduates, in this subject in many countries.

Secondly, the demand for those technology graduates is growing from industry, and industry, commonly, is able to provide a more attractive salary and incentives than the teaching profession. So therefore the supply of good, interesting, lively, graduates to technology teaching is often very limited. It is a vicious circle, because that means we are less likely to produce many good school technology students and so we enter a declining spiral.

At the university and polytechnic level we can often recruit highly able lecturers in technology, but there is a very similar problem. Once one gets a post in a university or polytechnic institution the emphasis in not on good teaching but on research. I speak as the person who chaired the teaching methods programme at my university for many years, trying very hard to ensure good teaching as well as good research. But at the end of the day, promotion is almost wholly determined on research and publication, teaching is one of the minor criteria. At a university I am familiar with (not my own) one notorious lecturer delivered an essential part of one of the technology courses. Students were obliged to attend because it was a core part of the syllabus. But their boredom was so great that they not only carved their names on the lecture room tables, they also amused themselves by floating paper aeroplanes and launching pellets at the lecturer. He was totally indifferent, as he stood writing away at the chalk board, not noticing what was taking place behind him. The university used to have two cleaners standing by to clean up the lecture room after each of his performances. In no time at all he shot through the ranks and was appointed full professor because his research was brilliant. He is now chairing a university department and the teaching of his department, I am sure, is not one of his major concerns. And so in the university system too, the fall-out rate of students in technology is high and we are losing, yet again, more of the potentially able people who could deliver effective technology education.

There are other major problems about technology teaching. At my university, we make technology an obligatory course for all our teacher training students. But that is because of our enthusiasm, not because it is required by law. Many teachers are, frankly, scared of teaching technology. A recent survey taken of British teachers, conducted by Wragg (1989) found that something like 70% of all primary school teachers were alarmed and felt ill equipped to teach technology even though, by law, they have to do so. Even more to the point, they have great difficulty when they do actually teach technology to make it interesting, attractive and involving.

Many teachers are making real efforts to engage children by involving them in decision-making, helping them to think creatively to solve problems rather than simply getting the right answer. But many teachers still give higher grades to children who get the right answers, rather than those who try to achieve an interesting and original way of working. For many teachers it is hugely important to get the right results; I have seen many children working hard to devise a way of solving a problem, only to find that it is not the way that delivers the right text-book result or the right combination of processes and so they achieve only low grades. The most able children find it boring and unrewarding.

Why do you think technicians are in schools? If we are perceptive we may agree they are there not so much to provide the equipment, but often, covertly, to help children to produce the right result by suggesting answers, offering them tools and equipment. It is the same as in the universities: if I go round many Engineering Departments I see students conducting experimental projects, with the aid of technicians. They are the same projects that are required every year, and the 'correct' results are known to the technicians and the students before they begin. There is no element of creativity or of imagination which is, after all, what we claim technology is supposed to be about.

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In university, just as in school, the laboratory technician's job is all too often to suggest to the student, 'you do not want to do it like that, you will not get the right result', and the right result is the same year after year. It is not an exciting experience, it is simply getting by. And as a result, the enthusiasm, the spark, the imagination, which many students bring with them because of their school experience, gradually get lost. And if those students become teachers they are conditioned to repeat the same kind of experience.

Of course, if we are not obsessed with the right answers, we will not obtain the conventional results and we have to adjust the process of assessment so that we can recognise the new, different things we are getting instead.

The way that technology is portrayed on television with programmes like *Young Inventors, Tomorrow's World* (all countries have these types of series) attempt to do something about it. Young Scientist Clubs, electronics magazines, hi-fi journals, are all talking a language that young people can respond to and commonly lead to high standards not only of creativity but also of skill and 'finish'. It is not a simplified, easy language, it is sophisticated, but young people can use it and do respond. We do not always spark that sort of enthusiasm in the schools or in universities. I know it is difficult for schools to match media resources — but we should try to make positive links with them.

In the technology area, there is a particular problem. Many people feel sad that the conventional levels of skilled performances are sometimes not as high as they were, because students are not focusing as zealously as they once did on absolute precision and quality of finish. One cannot have it all. But certainly the goals we have been going for in the past have not always served us as well as they might have done. The essential feature is for students to be able to feel proud of their product and if skill is necessary, we must help them to acquire it.

The Role of Industry

Now let me turn to the second of my headings. We do not always require industry to share as fully in the process of technology education as fully as we should. This is despite many attempts to engage schools and industry more closely as described by Innes (1995): 'There is no doubt if one want to show students the excitement, interest, attractiveness, and the economic rewards of being a technologist, then one has to find a way to introduce them to people who are actually working as technologists'. We have to get far more of those people in to the schools and help them to relate closely so that children will understand what technology is all about. This includes not just the excitement but also the routine work so they will really feel that they can understand the whole picture. We cannot eliminate boredom from industry any more than from schools. But we must justify it, not impose it.

Benson (1995), has described the key work in economics and industrial understanding at the University of Central England. At Warwick University too we have a large Centre for Education and Industry. We are running, with a number of other bodies, a whole series of schemes where we are getting industrialists into schools. In return we are getting teachers into industry, not just in some 'observing' role but to actually undertake projects in technology. We are also developing 'compact' arrangements, whereby children do not just go and spend time in industry, but actually get involved in an ongoing relationship with a local industry, which guarantees employment, if they achieve specified results in accreditation. It is very easy to say that there are unfilled needs for more technologists but actually turning those needs into jobs which students can obtain is not as easy as it seems. There has to be a real prospect of employment and it only becomes real when there is an understanding and engagement between industry and students, when each side knows what is really on offer. It is pointless hyping young people up for technology if we do nothing to ensure a reasonable level of certainty, of employment, a reasonably level of financial reward and status. All too commonly we have a situation of highly qualified, unemployed school and university leavers, and yet plenty of vacancies in industry. There is no point whatever in developing better technology education, unless we do something about linking it with the career, employment and labour market structure. It is a huge effort, but it is absolutely vital. And of course we need to realise that not all industrialists are unequivocally enthusiastic about young workers who know too much about how enterprises work, how wealth is created and profits distributed. We must also teach diplomacy and sensitivity.

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The Role of Students

Now I am going to my third area, and that is the young people themselves. Not because they are the least important, but because they are the most important. I am always uncertain whether to talk about pupils, students or young people. If I use all those terms, it indicates nothing more than my uncertainty rather than my confusion.

Somehow, one has to make technology related to their lives. This must include delivering not only jobs but feasible jobs, rewarding jobs, worth-while jobs and status giving jobs. It must also be related to their lives as consumers, parents and citizens. Putting it simply, technology has to be perceived by young people as life enhancing and only then will they have the motivation and enthusiasm to learn effectively. In our best schools and colleges we know that technology is motivating young people, not just through self-interest in being more effective consumers, having more interesting hobbies, or having a chance of a better job, but as a means of actually helping other people. For example there is huge enthusiasm among young people on technology courses for developing all kinds of strategies, aids and devices, that will help handicapped people, young and old, that offer better equipment in their homes and hospitals. Similarly, the enthusiasm of young people for environmental preservation technology and green technology generally is widespread and contagious. Technology can empower them. Here and elsewhere the altruism of young people is a hugely motivating factor, and we can help them to be more effective in their caring through technology.

I must end with some comments about the role of girls, because often it seems easier to achieve the kind of things I have been saying with boys who work with motorbikes, high-performance cars and hi-fi. I do not want to do anything to diminish the technological enthusiasm of young men in our society, but we are often less effective in involving women in technology. Yet, we have, with enthusiasm, the capability to do something about it. Research (Dale, 1972) shows that girls are usually much more involved and much more successful in technology in girls' schools rather than in mixed schools. There are many reasons, but one simple and obvious one is that they are often 'put down' in mixed schools by the boys, who see themselves as more likely to be successful, and who crowd out the girls in their bid for teacher attention.

I was at an excellent technology lesson recently in a comprehensive school in Manchester. But when the teacher put the apparatus out she said, 'When you are ready, come forward and collect the apparatus. There is not quite enough for everybody, so those who are ready can use it first and those who are not quite ready will be able to use it next.' There was a rush for the apparatus. At the end, all the boys but only two of the girls had apparatus. This happens time and time again. It is hardly surprising that some girls find technology less interesting. We have to do something about that and as most education is now in mixed schools it is a major problem.

So there are fundamental problems in helping students, boys and girls, children of all abilities, to see themselves as being able to succeed in technology and of course, assessment procedures, guidance procedures, support systems and the way in which we organise classrooms are crucial in ensuring that that takes place. It is exactly the same at the universities: we have many women science students but they are mostly biologists. At graduation day every year there are two or three brave young women, who have succeeded in obtaining an engineering degree. Because they are so exceptional they get a special cheer as they come to receive their award, otherwise the ranks are solidly male. They get almost the same cheers as handicapped students when they come to the rostrum.

Let me reiterate, in conclusion, that I am impressed by the initiatives in many schools and colleges, but alas they are not enough. The only way in which we can really progress, is to engage technology in the education and self-image and life-style of every citizen, in their roles as workers and as consumers in a modern society. We have to make every citizen technologically capable and literate. It is just as vital as all the other basic life skills that are taken for granted.

In the twenty-first century those life skills have to be enhanced by what we, specialists in our subjects, can offer. Only then will any country be equipped to move forward as a fully developed twenty-first century society. If we fail, we imperil our societies. If we achieve, we can all go forward together. Let me finally

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remind you, lest you ever think otherwise, that there is no basic human deficiency. We are all of us, at our different levels, capable of achieving: remember the examples I gave you earlier. Human capability can deliver it; as teachers we can interest, motivate and engage. Putting children on the leading edge of the learning curve is a vast responsibility, one that I take more seriously than anything else in my professional career. We have a million miles to go, but it is a journey that we can and must accomplish.

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Criteria for Success

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Rob Johnsey examines the close relationship between the design specification and evaluation of designed products at primary level

Evaluation is a skill which teachers would like to encourage in all areas of the curriculum but its special importance to design and technology was highlighted by making it the title of Attainment Target 4 in the current (1990) orders. During subsequent consultation documents the AT was relegated firstly to a strand (DFE, 1992) and finally a section heading in the current draft orders (SCAA, 1994). This, quite correctly, was in recognition that evaluation, while being a skill with its own unique attributes, is constantly carried out throughout the whole process of designing and making.

There is often much confusion over the word evaluation as used in the context of D&T. It frequently gets mixed up with concepts such as pupils' self-evaluation and teachers' assessment of children. In this article evaluation is taken to mean the judgements that pupils make about:

— *products* which have been designed and made and/or

— the *processes* which have been used in designing and making.

Baynes (1992) suggests that evaluation has two distinct branches: 'There is first the ability to appreciate, analyse and debate what others have done. . . The second is the ability to analyse, criticise and learn from the child's own activity'. In the second example there is a danger of confusing the evaluation of the learning process with the evaluation of the design process. It would be relatively easy to ask a pupil to make judgements about how something was designed and made but quite difficult for that pupil to evaluate how effective his or her own learning was. To clarify the picture, we can think of pupils making evaluations of four different aspects of design and technology:

- their own design and technology work as it proceeds — *on-going evaluation*
- their own work when it is finished — *summary evaluation*
- their own procedures — *procedural evaluation*
- the designed work of others.

More effective evaluation

So what is involved in evaluation in design and technology and what strategies can teachers use to encourage good practice? How can teachers move on from simply asking pupils 'What do you think of your model?' or 'How would you improve it if you could make it again?' and receiving the inevitably brief and unimaginative answers?

The key lies in another major skill used in designing and making which is closely related to the skill of evaluation. This skill, *specifying the purpose of the product*, is an essential precursor to 'making good quality products fit for their intended purpose' (DFE, 1992). It has, perhaps, suffered from neglect (especially by primary teachers) and yet, without it, evaluation becomes rather superficial and meaningless. In asking pupils to state the purpose for which their product is to be made and what they hope it will achieve we are asking them to set out the criteria against which they can later make their judgements. Once these criteria have been established the methods of evaluation follow naturally.

I recently worked with a class of Year 2 children who were involved in a topic called Summertime. Their task was to design and make a model of a picnic box using card strengthened with short wood strips. In the early stages I used a large sheet of paper and agreed, with the children, a set of criteria for the picnic boxes. The boxes should:

— be strong enough not to crush the sandwiches and fruit

— have sections inside to keep the various items separate

— have a carrying handle

— have a catch which held the lid closed securely.

Every so often, as work proceeded, we would look at our list of criteria as though it were a guiding light. Using the list, children would be constantly evaluating their work to ensure that it conformed with their original intentions. The children themselves added their own, often unspoken, criteria for success and made evaluations against these too. Some chose to have a compartment for a drinks bottle, others specified their own kind of decoration for the box. During their *summary evaluation* the children were able to say much more about the success or otherwise of their products because

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they were looking at them with a variety of criteria in mind.

Do children set criteria naturally?

Constable (1994) suggests that children at Key Stage 1 do not 'automatically establish their own criteria for evaluating their work'. During a SAT which involved making protective headgear she noticed that the children were uncritical of the fact that the hats offered no protection from the sun or wind or rain despite the fact that these were clearly the criteria for success. I would suggest, however, that these criteria were imposed on the children within the testing situation and in fact the children probably had their own more realistic agenda which involved making hats for their own implicit purposes. These might have been that the hat should fit their heads, look good, involve using interesting, stimulating materials that they like to handle and so on. Clearly it is important that children are themselves involved in establishing the criteria by which their products might be judged.

Any design and make activity will be based on some kind of purpose which, in turn, will involve some criteria for success. These, in many cases, will be left unstated and may even be a little vague in the designer's mind. They may even change in the light of experience, as work proceeds. One Year 3 child I was observing began making a lorry for his mother but soon changed his specification for the model when he found he could not obtain and fix on suitable wheels in the time allowed. Instead he made a model boat using strips of wood which he enjoyed cutting, and added features which he knew would please his mother.

It would be reasonable to assume that, in children's minds, unstated criteria exist which may, indeed, be changed as designing and making proceed. We can think of these criteria being related to three aspects of the work in hand:

— the function of the product

— the client for whom the product is intended

— the learning experiences which the pupil might want to have.

Objective and subjective evaluation

The teacher's task is to encourage children to be clear about their own criteria for the success of their own design products and then to relate these to any evaluation made. In a recent design exercise with a group of BA students based on a topic The Supermarket, they were asked to state the criteria for judging a variety of models they were about to produce. This was not an easy task at first, many of the criteria such as 'Safety' being too vague to be used for evaluation purposes. Through discussion it became possible to refine these

Table 1

Product	Criterion	Subjective methods of evaluation
Supermarket trolley	Should separate fruit and vegetables from rest of shopping	Success / failure judged by potential users of the trolley
A new cereal	Should look good	Judging panel gives score out of ten for each sample
Display stand for sweets	Should attract children	Observation of stand being used in the shop
Supermarket shopping bag	Should have comfortable handles	Ask a group of consumers to test subjectively and give opinions
		Objective methods of evaluation
Supermarket trolley	Should hold 500 cubic centimetres (scaled down week's shopping)	Find out how many centimetre cubes the trolley will hold
Design a new cereal	Should not contain any added sugar	Yes / No
Display stand for sweets	Should allow sweets to flow smoothly into bags	Test operation a number of times for reliability
Supermarket shopping bag	Should have comfortable handles	Measure the amount the handle of a loaded bag presses into a lump of Plasticine.

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Table 2

Strategies for teachers to help children evaluate

General
Value children's responses and opinions.
Create an atmosphere of trust and respect for other's opinions.
Help children to see that self-criticism is a virtue rather than an admission of failure.
Give children time for reflection before asking for evaluations.
Ask searching questions about the product and processes involved.
Encourage pupils to ask their own questions by providing examples.
Promote group work in making evaluations – sharing ideas leads to more objectivity and less sense of personal success or failure.
Encourage oral responses where children find writing tedious or difficult.
Provide tape recorders to increase motivation.
Use a points scoring system for different aspects of a product; add the scores to get an overall picture.
Provide evaluation sheets with focused questions to guide pupils.

Children's own products
Encourage children to be aware of the purpose of their designed product.
Set criteria for children which they can use for their own product.
Encourage children to set out their own criteria against which their products might be judged.
Use any criteria established at the beginning in any formal evaluation later on.
Discuss possible improvements to parts or all of the product.
Develop ways of making subjective evaluations more objective, e.g. involve more people in the judgement.
Use scientific testing to make objective judgements.

Others' design products
Encourage children to discuss the purpose for a product.
Encourage them to put themselves in the place of the designer. Ask "What were his/her intentions?".
Encourage close observation of the products of others. Use all the senses.
Make observational drawings.
Use aids to observation such as hand lenses.
Help pupils to focus their observations on relevant parts of the whole.
Compare items which have a similar function, e.g. different types of can opener.
Identify mystery objects.
Compare products from other cultures and times.
Focus on the materials used for construction and why these, in particular, were used.
Focus on such features as shape, mechanisms, use of energy and the way the product is controlled.

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broad ideas and state them in more concise terms. It became clear that certain criteria would lead to subjective judgements while others would lead naturally to more objective testing. Table 1 shows examples of these criteria and the suggested method of evaluation.

Evaluating others' products

Design and technology is not just about pupils designing and making products, it is about their wider understanding of the designed world. Baynes (1992) puts it neatly when he suggests that '. . . a study of things which have been made will help us in our own design and technology work, but equally . . . our own design and technology work will help us to understand things which have been made'. When pupils evaluate the designed products of others they should be encouraged to exploit the link between design specification and evaluation. Beginning with the question 'What did the designer set out to achieve with this product?' will enable pupils to make sound evaluations later. It will highlight the fact that professional designers as well as the pupils themselves will begin with a purpose in mind and will have implicit or explicit criteria by which to make later judgements.

Strategies for encouraging children to evaluate in D&T

In the classroom teachers are beginning to explore in more depth how children evaluate their work and how this skill might be enhanced and encouraged. Table 2 shows a list of strategies that a teacher might employ to encourage effective evaluating by pupils. It is partly the product of a school-based assignment carried out by practising primary teachers on a 20-day course in design and technology at Warwick University.

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Problem Setting in D&T — a Personal View

John Durrell

University of Greenwich

Achieving a balance between closed tasks in which pupils learn skills and more open-ended tasks in which pupils may design their own problems can be difficult; a new approach, John Durrell argues, might be the solution

Though there appears to be little research done in the area of problem setting in D&T, there do seem to be two distinctive methods of approach. Traditionally there is the 'handicraft method' which suggests that learning is skills based, and where each child produces an identical artefact and is usually taken through the skills of making that artefact in a step-by-step manner. The end result is normally a number of practical pieces of work all rigidly assessed on the criteria of how well the child has followed the teacher's plan. This method, as it is relies on very basic learning, may be little more than learning by rote. In contrast, the second method is a 'first principle' approach. This is where children are working from the need to solve specific problems, perhaps generating the problem themselves, designing a solution, and using craft skills as a means to an end rather than as an end in themselves.

These views are extreme ends of the spectrum. Some may want to argue that the step-by-step approach should only be used initially to acquaint children with tools and processes to give them a better understanding of the possibilities in construction techniques. When designing and facing problems from first principle, the child needs to be literate in constructional techniques and therefore be able to design with constructional literacy. The danger here, of course, is that the child may fail to link constructional techniques with first principle problem solving, or may have failed at first principle problem solving because of the lack of constructional literacy. This is clearly a dilemma.

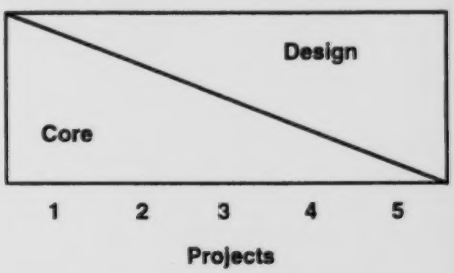
A core-based approach

Learning within D&T needs to be staged so that children are given problems to solve at a level with which they can cope. We do not normally find high diving being taught before the person can swim, yet we do tend to find D&T problems being set to children who have not been given sufficient experience in designing/making skills to allow them to solve such problems successfully. An intermediate approach, which is evident in some schools, moves the children in a structured framework which is aimed towards the ultimate goal of children being able to work from first principles. This method I would call 'core based'. Here the child is given part of a problem already solved, which forms a core; for younger children, for example, this could be a simple string puppet where the child would be given the basic construction and then asked to design the character by decorating and clothing the puppet. The child may also be asked to work in collaboration with others to write a play including the puppet as a character, and then to produce a theatre in which to stage the play.

Solutions to this type of problem can be complex or simple and can marry into and build upon the level of existing constructional literacy with an assurance of success implicit in a well designed 'core'. As the child becomes literate in both the designing process and in constructional techniques, the given core can diminish (as shown in the diagram).

Many children appear to enjoy working in the practical D&T workshop environment and the 'core based' approach encourages this. It can introduce children to making skills in the building of the 'core'. Simultaneously, the design process is begun in the problem-solving part of the project, which allows children to design using, as designer, the armoury of constructional skills learnt from the core.

Although the problem-solving process needs considerable monitoring, particularly for children who are acquiring designing skills, this 'core based' approach allows the teacher to monitor design work within the problem-solving aspect of the project while the children are engaged and motivated in the practical skills acquisition stage — the 'core'.



Core — as children gain in expertise the core is diminished
Design — as the core diminishes the child's design input increases until the children are able to generate their own problem to be solved.

It is the aim of this approach that ultimately the child will have acquired sufficient design and make skills from core-based projects to generating his or her own problems to solve, and thus become an autonomous learner, armed

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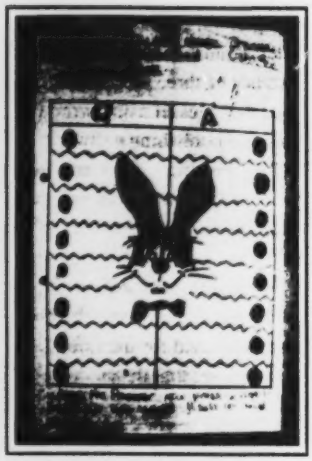
with the practical design and make skills to solve, make, test and evaluate the problem which has been initiated.

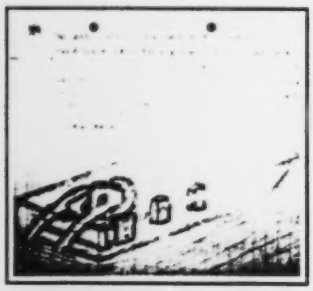


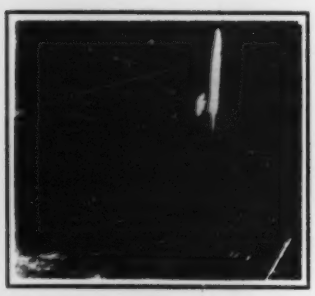
Some examples of 'core based' projects

Question and answer games

Children were asked to build a container (the core) to hold a Question and Answer game. While the children were working on the skills involved in making the container, they were simultaneously asked to build a game, to fit the following design criteria: it should be played by two children while on a long journey, and fit into the container; when the question is answered correctly, a light comes on. The emphasis of their design problem was to ensure that the child answering did not just get the correct answer by memorising the circuit positions. The circuit must be able to be easily altered to overcome this. The game was also required to have a theme.

With this approach, children can be involved in workshop activities, while also being engaged in design work. The children's designs can be monitored by the teacher before they are acted upon. At the same time an armoury of constructive skills and constructional design literacy is being built up by the child.





Two approaches to boat design

Boat — a double-barrelled core

In this task the children are asked to design the hull of a boat. This could be material based, i.e. to teach plastic skills such as vacuum forming. In the example shown, working in sheet metal with the use of developments, was the main constructional skill.

While working on the hull, the second part of the problem (which would need careful task setting and monitoring by the teacher), is for the children to design a means to power the boat.

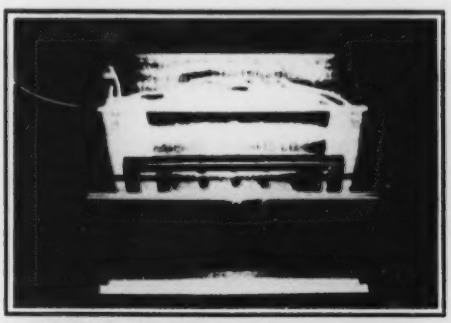
Clock Project

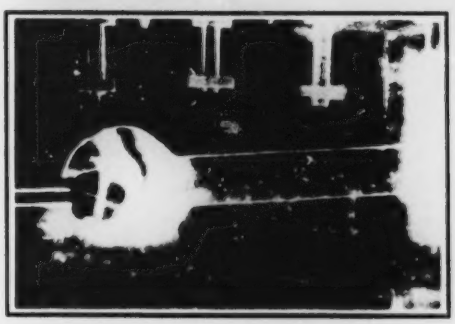
With this task, the core is now diminishing, relying on much more design work from the child. The project could be set after children have built up a range of constructional literacy from previous 'core base' projects.

The core for the clock project was the clock mechanism. The children had to find their own context for the clock and to then develop their own design brief, after initial research. The amount of design input and problem definition is much greater, with the core input being correspondingly smaller.

Photostress Analyser

The Photostress Analyser was a project where the child identified the problem: the need to test shapes for stress. After identifying the problem, the child had to design, make, test and evaluate a successful solution based upon the previous experience gained with earlier 'core based' projects.





The photostress analyser and a picture in action

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An Elementary Approach to the 21st Century

Gioia Caiola Forman,
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Technology as a subject may be discrete, or peripheral to other subjects or it can be fully integrated in the whole curriculum, as in this American elementary school

For us, technology is defined as the application of knowledge to solve problems. At Dranesville Elementary School, Fairfax County, Virginia (on the outskirts of Washington DC), the students (900 aged between five and twelve) and staff are encouraged to use a variety of equipment computers, laser disc and CD-ROM players, hand tools and manipulative toys to solve problems and develop skills in critical thinking. Understanding what technology education is, its ramifications for school and society, and properly delivering its instructional content and opportunities to students has been the major thrust undertaken by the administration and staff at the school.

At Dranesville, technology education includes both information and design technologies. The information technologies include several types of computer equipment used as tools to supplement the curriculum. Classrooms are equipped with Apple IIe or Macintosh LC computers (Kindergarten up to Grade 3) and Apple IIgs computers (for Grades 4-6). Two of the Macintosh LC computer stations have CD-ROM players that enable students to use talking books or other multimedia resources. Two IBM-compatible computers are available to students in a mini-laboratory. In the lab, students can use computer-aided design (CAD) and animation software to produce illustrations for special research projects or books. Students use the computers in small- and large-group instruction as well as individually. The school has more than 200 software programs that allow students to develop problem-solving skills, participate in simulations and reinforce skills.

Designing and making sailing ships

Technology throughout the curriculum

Technology is integrated with the whole curriculum. Upon completing a social studies unit on the early explorers, for example, students constructed a sail-powered vessel that would travel a distance of three feet. Young designers described their vessel using word processing and desktop publishing software. They kept track of the materials that were used in the building process by creating bar and pie graphs with graphing software. Once the vessels were tested, the pertinent data (length and height of the vessel, etc.) was collected and analysed with database management software. A graphics program was used for the final representation of the vessel that the students designed and built.

There is evidence of technology programs throughout the school: in hallways and pod areas as well as in classrooms. Students have the opportunity to explore a variety of toys and materials that involve them in problem solving. Puzzles, Lincoln Logs and Tinkertoys encourage students to build and expand on creations. The school library offers opportunities to use computers and multimedia equipment. There is a computerised catalogue and MANDY (subject-search software) to help students in their enquiries about authors or titles and CD-ROM players which enable students to access electronic encyclopaedias or information about subjects which interest them.

Laser disc players and videodiscs are used as teaching tools (especially for demonstrations, simulations and electronic field trips). Students can thus travel to the National Zoo, the National Gallery of Art or the Grand Canyon! In a study of rocks and minerals, students used the Windows on Science series laser disc to obtain information about a design brief. Their challenge was to make a device that could move a heavy rock. The laser disc had many clips of simple machines that aided students in solving the design problem.

Telecommunication activities are available to all students. The activities vary from sending Valentine messages or participating in treasure hunts to collecting scientific data on weather conditions. Students produce and edit their own videotapes. The school's communications studio is equipped with two editing decks and with monitors that allow students to make professional-looking videos for classroom

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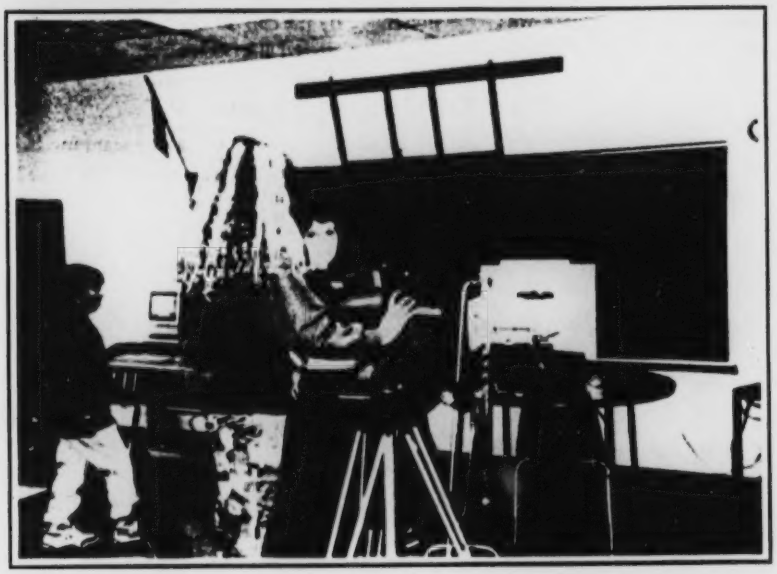
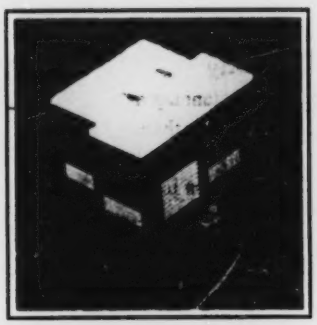


Students produce and edit their own videotapes

projects. Students can also create graphic presentations with the computer and then add voices or music to complete a video. They use the video cameras to tape segments that are used for the schools news network, WDES. Closed-circuit television allows students to view the news, see special guests or visit other classrooms.



A device to help the rats of Nimh

A problem-solving approach

Design, or engineering technology, is about identifying needs, generating ideas, planning, creating, testing and finding the best solutions. Technology activities, using a design brief format, help the students become aware of ways in which technology affects home, work and life-styles. Technology activities supplement lessons in language, mathematics, science, physical education, music, art, health or social studies. The activity can be thought of as a mathematics or scientific concept.

Teddy bears are all around the school to help create a child-friendly environment. After studying literature involving teddy bears and reading and dramatising a story about the teddy bears' picnic, first grade students designed and made a waterproof hat for the bears to use during inclement weather. They explored the properties of materials and made choices to determine which were appropriate for meeting their needs. A news segment was videotaped and shared with the rest of the school population via the closed-circuit TV facility.

A group of musicians from Bolivia recently presented an assembly at the school. The music teachers challenged the students to design and make an instrument that duplicated the sounds that they heard in the native music. Students discovered the relationships between materials used and their effect on pitch, resonance and volume. One technology activity involves kindergarten students in designing and constructing ears for Mickey Mouse, another has first graders designing and testing ways of lifting blocks, and second graders creating vehicles to move items from one place to another. A further activity explores the challenge of a diver using air tanks and weight belts to try to get to the bottom of a pool of water; students are inspired to design and construct safe diving gear. In the upper grades, children studying insects design their personal bug and describe its purpose, habitat and living patterns. They then mechanise the bug using electric, pneumatic or elastic power.

In design technology activities, students use CAD or graphic software to create a design plan or blueprint for their project. The students build their project using their hands and hand tools to assemble paper-towel rolls, rubber bands, string, fabric, straws, wood, manipulative toys (Lego, Gearopolis and Tinkertoys, for example), and simple machines. The design process is documented in reports and drawings that are prepared using desktop publishing software.

The novel *Mrs Frisbee and the Rats of Nimh* by Robert C. O'Brien, introduced students to a technologically advanced community of rodents. Students then worked in teams to design labour-saving devices for the rodents. They brainstormed ideas and drew several solutions, chose the best one and drew a scale model of the device. They then used Lego to construct the model and tested it to ensure that it met their purpose. All models and plans were shared so that all the students could benefit from the learning experiences of each other.

The excitement and involvement of students is evident throughout the school. The staff is committed to making technology the new basic as they integrate it in all aspects of the curriculum and prepare children for the future.

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Working together, working alone: parallel projects for developing understanding

Bridget A. Egan

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In schools, group work is common in D&T, but how easy is it to work in a team, and do adults need to practise team skills as much as children?

As teachers, and as advisers of teachers, we frequently recommend that pupils undertake projects working in groups, both as an organisational stratagem and because we wish them to experience team working. Teachers usually have personal experience of working as members of planning and assessment teams, and many have had experience of work in teaching teams, but relatively few have had experience of being in teams to design and make products. Yet this experience may be radically different from work in teams with other objectives, particularly if the intended outcome is not a single product but a batch of products.

For this reason we consider it important that students should learn at first hand what group design work can be like. The students described here are in the second year of our Primary BA(Ed.), specialising in Design and Technology. One aspect of the course requires that they work together in groups to design and manufacture a product. The group size here is usually nine or ten, thus a year group will be organised into two or three teams.

The Batch Production project

The structure of the project is as follows: in the third week of the project, each student produces a design proposal for an artefact to be made by the group working together. 'Production Day' for this is fixed for a single day in the final or penultimate week of the term, and each team of n students must produce a batch of n+l products on that day.

Week 3 includes an exercise through which the group arrives at criteria for choosing a design to develop. Each design is then presented by its author, and each member of the group rates it against the criteria. Aggregate scores are derived. The group is now in an interesting situation: they have collectively drawn up a list of 'rational' criteria, such as visual appeal, ease of construction, and so forth, but the highest-scoring design is not necessarily the one which becomes the final choice of the group. The criteria inform, but need not control, the choice. It has happened that the majority of group members prefer an alternative design, either because the balance of criteria is nearer an optimum, or because factors which are more subjective come into play. If the latter is the case, these need to be articulated in the group, so that a clear set of criteria whereby the choice is finalised can be presented. By the end of this meeting, groups must have arrived at a choice.

Forming a team

They now need to form a working team for their batch production. What needs to be done? How can it be achieved most efficiently? How do we progress our individual learning targets through this project and also make an effective contribution to the group? How will communication within the group be ensured, and the effective working of the team be controlled, with everyone pulling their weight and making a positive contribution? Each group has regular meetings to monitor progress, to which a tutor may be invited if help is needed.

The teams progress on the project by modelling the ideas, refining and prototyping the chosen design, and preparing jigs and systems to aid the manufacture. Good ideas from rejected designs are often incorporated during the refining process. The process of team development is often an issue which is only recognised as stresses in the team demand attention, and the art of making criticisms while at the same time keeping the team together and on track is sometimes painfully learnt.

Production Day

A great deal of detailed planning and preparation is undertaken for the Production Day itself. The team may be sub- divided into work groups, or a production line organised. Timings for various parts of the production process need to be estimated. Materials need to be prepared, and cutting and drilling jigs made and mounted ready for use. Some components may be prepared in advance, others must be made on the day itself. Batch Production Day is invariably and inevitably hectic, bringing unforeseen tensions (the paint doesn't dry fast enough, for example, or another team has booked the bandsaw) and some ingenious solutions to problems (last year one resourceful team member organised relays of students to carry the painted components into the ladies' loo, where the hand dryers could be pressed into service). The sense of achievement in completing the batch production is almost its own reward!

The benefits of carrying out a group project of this kind are manifold. Students learn at first hand about aspects of production management

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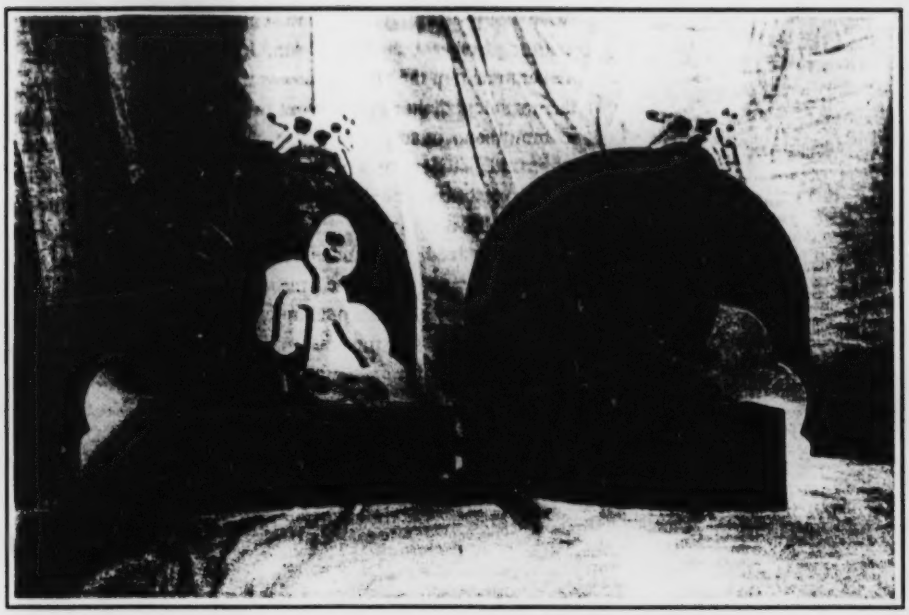

'The dish ran away with the spoon': two examples from a batch of ten demonstrating a basic crank mechanism

which are not accessible through an individual approach to project work. They also learn, through the group process of criterion setting and the design 'competition', to apply greater rigour in their choice of personal project pathways. Of vital importance is learning to operate as a member of a team, and the concomitant understanding that a team cannot function well unless team members understand not only the objectives that have been set for their work, but also how to:

— manage group processes within the team
— deal with tensions
— express criticism and disagreement
— handle criticism and disagreement from others.

Team evaluation

Students review their contribution to the team and seek the views of other team members on their contribution, as part of the self-evaluation process. Tutorial support includes seminars dealing with group processes, and tutors monitor the team process, which is taken into account in assessment of the unit. It is hoped that the greater awareness of the needs of teams and team members thus generated will assist these intending teachers in supporting pupils in team projects later on. Students are enabled and encouraged to learn from each other, to value each other's skills and ideas, and to seek advice from each other as well as from tutors.

Individual projects

Until this year, the batch production exercise took place in the Autumn term. The term's units of subject work demand that students develop their own skills and understanding of mechanisms, and that they carry out design project work based on that understanding. The term's work starts with the stimulus of a museum visit to London, where the Museum of Childhood in Bethnal Green displays a wealth of toys, educational and recreational, old and new. The trip also includes visiting Paul Spooner's Mechanical Cabaret in Covent Garden, and students are both inspired and impressed by the range of creative possibilities which is opened up to them here.

Alongside the specialist teaching input, often using kit materials for modelling and testing mechanical systems, students undertook two parallel projects. The brief in each case was to design a 'tabletop' toy to stimulate children's interest in mechanisms — a fairly common project in many institutions. However, the projects had two distinct outcomes, of which one was personal, and unique, with relatively tight constraints placed on the design, while the other was constrained only by the requirements of the batch production.

Why do two projects in parallel? Discussion with students revealed a range of opinion, from those who felt that parallel demands offered them an opportunity to seek relief from one project in attention to the other, to those who found the simultaneous deadlines too great a

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source of pressure. Observation suggests that learning from one did indeed support development in the other. Moreover, the time management demands of having two commitments of such very different natures confronted students more strongly with the need to prioritise activity, to set targets realistically, and to maintain commitment to targets and deadlines. Students were enabled, on the one hand, to achieve time savings in each project by carrying out similar tasks on each in a single working session (when sketching ideas, for example). On the other hand, it is only rarely that a mishap of planning or accident prevented a student from using working time effectively on both projects.

Serial projects

This year, the two projects occurred for the first time in separate terms, with the introduction of a new structure for the BA in Education. This entailed some significant changes in the nature of both projects. The individual project continues to be tied to the theme on mechanical systems. The group project module is now freed from that particular constraint, but continues to involve batch production of a functioning system. The teams concentrated on designing a modular and portable display system for school/INSET use. It was certainly easier for the students to concentrate on the needs of the batch production, since no other project work acted as a distraction. Team functioning has on the whole been less difficult than in previous years. The quality of outcomes has been high. Whether the transference of learning from this into individual projects will be maintained, remains to be seen.

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Partnership Schools, Universities and the Shortage of D&T Skills

Tim Lewis

Sheffield Hallam University

Successive revisions of the Technology curriculum have placed more and more demands on the subject skills of the D&T teacher, but how well do newly qualified teachers measure up to the requirements? Here Tim Lewis provides evidence that shows that this is an area for concern.

Design and Technology teachers who have links with universities providing teaching practice placements will be aware of the changes in the training of teachers, particularly the development of partnerships, with teachers taking responsibility for certain aspects of training. Partnerships between schools and Higher Education Institutions (HEIs) have been established in the last three years with schools being far more involved in course design and implementation. Many D&T teachers have taken an active role in these developments including being involved in new course design and delivery as well as taking the opportunity to be trained as mentors in preparation for the supervision of students on teaching practice placements in their schools.

The majority of initial teacher education (ITE) courses have included school experience or teaching practice after students have received some teaching in the HEI, so the new recruit to the profession has had an opportunity to become more aware of the skills and knowledge required by the D&T teacher. New recruits to D&T teaching come with a wide variety of qualifications and experience, which can be seen as an advantage or as a problem for the teacher educator. While four-year degrees continue to attract the 18-year-old student into the profession there is no doubt that the postgraduate certificate in education (PGCE) for students with a degree and two-year BEd. courses for people with Higher National Diplomas/Certificates (HND/C) are a main source of supply of new D&T teachers. Many readers will have entered the profession by one of these two routes. While the supply of students has been adequate, training via these routes poses many problems. Staff in HEIs will be familiar with these, but now that partnerships are established, teachers in schools need to be aware of the problems too, and be involved in developing strategies to overcome them.

The problem this article addresses is the suitability of qualifications for entry to a D&T teacher education course with particular reference to skills. At Sheffield Hallam University the word *alignment* has been used to describe the appropriateness of a prospective student's qualifications and experience for teaching D&T. A PGCE student with a degree in D&T is said to be *in alignment* (at present there are few D&T first degree courses), a product design student *in reasonable alignment* but a fine art degree would be *out of alignment*. Similarly, an HND/C qualification in engineering is *in reasonable alignment* but one in computer science is *out of alignment*. (It is recognised that qualifications can only be used as a starting point in the selection process as some applicants *out of alignment* may have other experience which brings them more into alignment.)

Knowing that students are entering training with different levels of alignment, it follows that we need to design courses which can bring them *into alignment*, that is, fill in the gaps in their D&T knowledge, skills and understanding, as well as train them to teach. An in-house study at Sheffield Hallam University has provided data about the extent of mis-alignment in two-year BEd. and PGCE students as well as focusing on those aspects of D&T which need to be taught to ensure that the student leaving the courses will be adequately prepared to teach the D&T National Curriculum.

Before teacher education courses can deal with this situation, however, it is necessary to have a clear picture of the core skills required by a D&T teacher. This can be difficult as the D&T profession has not always been in agreement about this, so the Technology National Curriculum documentation has been used for guidance. In the first instance, *Technology for Ages 5 to 16*, (1992) and subsequently *Design and Technology in the National Curriculum, Draft proposals: May 1994*. Interim documents such as *Technology: Programmes of Study and Attainment Targets: Recommendations of the National Curriculum Council* (Sept. 1993) have provided guidance. The data used in this article has been collected from three cohorts of students entering D&T PGCE and two-year BEd. courses at Sheffield Hallam University, the number involved being 124 (four-year BEd. students have not been included as their course is designed to cover most aspects of D&T and is sequential to A level).

All students taking part in the study completed a questionnaire which asked them to state their previous course and qualification used as the basis for entry to teacher training. This was followed by a list of key skills and areas of knowledge associated with D&T. Respondents were asked to indicate the extent of coverage of each skill or area of knowledge in their previous course or employment using a three-point scale of *none, limited coverage* and

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covered in detail. As stated earlier, the key areas of D&T were derived from drafts of the emerging D&T National Curriculum which seems to progressively identify D&T skills, knowledge and understanding more concisely. The questionnaires were issued early in courses but after students had made visits to schools so they were more aware of the skills and knowledge required by the D&T teacher. A considerable amount of data has been collected and used as guidance in the development of new initial teacher education courses at the university. For the purposes of this article, five key aspects of D&T are analysed and comparisons made between the D&T capabilities and shortfalls in expertise of the two student groups.

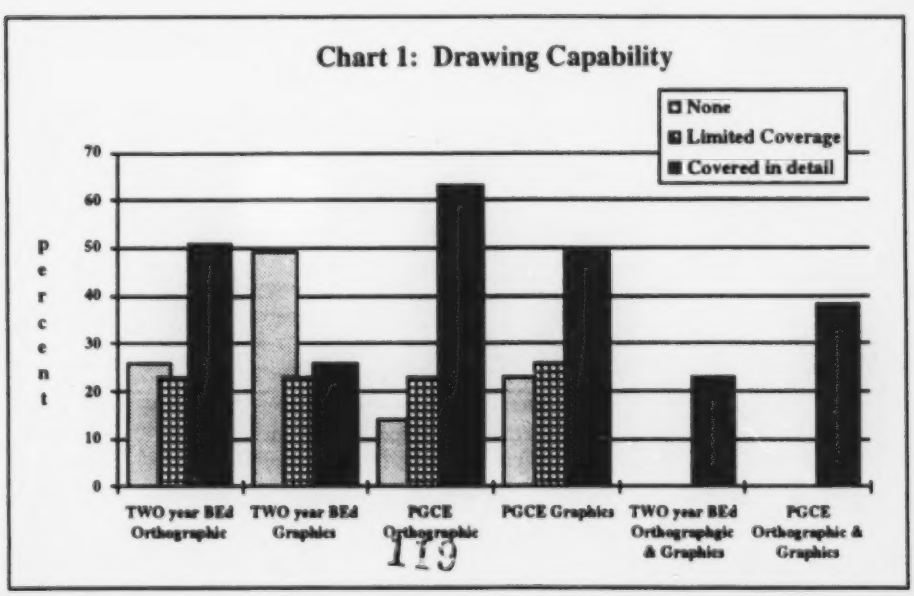
Design processes

As design processes are a fundamental aspect of D&T teaching it seems reasonable that students should have an understanding and working knowledge before they can be effective in the D&T teaching environment. Students entering the two-year BEd. degree were weak in this aspect, with only 26 percent having covered this in detail in previous courses; this compares with 74 percent of PGCE students with only 9 percent having not covered this topic at all. The PGCE students without knowledge of designing usually come from backgrounds similar to the two-year BEd. students, that is mechanical engineering with industrial experience. A more detailed analysis shows that 84 percent of students with an HND/C or a degree in a design-based subject were fully aware of design processes whereas only 25 percent of engineering HND/C and degree students had a sound working knowledge. Students with technological backgrounds such HND/Cs or degrees in electronics or computer studies fare no better, with only 23 percent having covered designing in detail. It is reasonable to expect that any higher-level design course would cover this in detail, so it is surprising that few technological or engineering courses have provided even limited coverage. Discussion with students with engineering backgrounds revealed that while they did units or modules called 'design', the tasks set were usually very restricted with little or no teaching about design processes. In many cases they had been asked to complete half-finished solutions to engineering problems. Some had completed projects based on a manufacturing process which were usually descriptive.

Drawing Capability

The ability to represent ideas by drawing is one of the fundamental skills required by the D&T teacher yet this study shows that there is a considerable variation in students' expertise (and even understanding) of terminology associated with drawing. Some students have an excellent understanding of orthographic projection whilst others are fluent in representing ideas using a range of 3-D presentation techniques; however, the D&T teaching profession requires expertise in both these areas. The questionnaire separated these two aspects of drawing so it was possible to

Chart 1



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see which students need teaching orthographic skills and which require the numerous skills of representing ideas in a 3-D form, such as perspective.

Chart 1 shows that more than half the two-year BEd. students have covered orthographic drawing and for PGCE students this is significantly higher, at two thirds. This seems to indicate that degree course content includes more teaching of this topic than HND courses. For 3-D graphics the two-year BEd. picture is weak, with only 26 percent of students adequately covering the topic. However, PGCE students are in a much stronger position with virtually 50 percent having covered the use of 3-D graphics. The two columns to the right of the chart show that over a third of PGCE students have studied both these aspects of drawing and should be able to cope well in school. For two-year BEd. students this is less than one quarter.

There are many intermediate situations where students will have some knowledge of orthographic drawing yet be well versed in 3-D graphics work. It is possible to analyse the data by qualification which shows that 70 percent of students with an HND or a degree in engineering will be able to deal with orthographic drawing but only 10 percent have had the opportunity to do 3-D drawing work in their previous course or employment. Clearly teacher education courses need to provide appropriate teaching for both categories of students so they can build expertise in those aspects of drawing where their previous experience is limited.

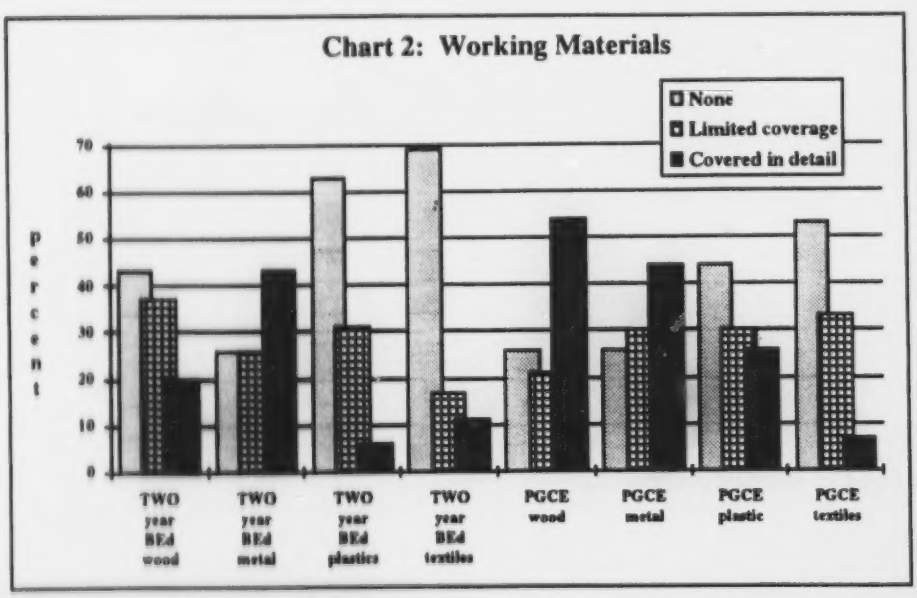
For the teacher in school planning a student's timetable it would be unrealistic to ask the majority of students with an engineering background to teach 3-D drawing work in the early stages of their training course, yet many would be able to cope satisfactorily with orthographic work. The problem is that in most schools it is not always possible or desirable to separate the two.

■ Working with materials

Design and Technology in the National Curriculum, Draft proposals: May 1994 sets out under the heading Knowledge and Understanding the requirement that pupils should be taught how to work with a range of materials. For the purposes of this study the questionnaire dealt with wood, plastic, metal and textiles.

One regular point of discussion between teachers in schools and university staff in recent years has been the issue of skills, usually centred around the lack of a student's practical skills when working with materials, tools and machinery. The chart below shows a varied picture regarding practical capability. It would appear that PGCE students have, as a group, the best capability with wood, metal and plastic with slightly more than half the students having covered working with wood in detail in their previous course. (Wood is a popular

Chart 2



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DIY material therefore it is possible that some students have gained expertise in this way.) Just over 40 percent of both the two-year BEd. and PGCE students have dealt with metal in any depth with similar numbers, 25 and 30 percent respectively, having a limited experience. It is interesting to note that as a group the two-year BEd. students have a stronger 'metal' profile (43 percent) than 'wood' (20 percent); more detailed analysis shows that this is because the course regularly recruits students with an industrial background, particularly engineering.

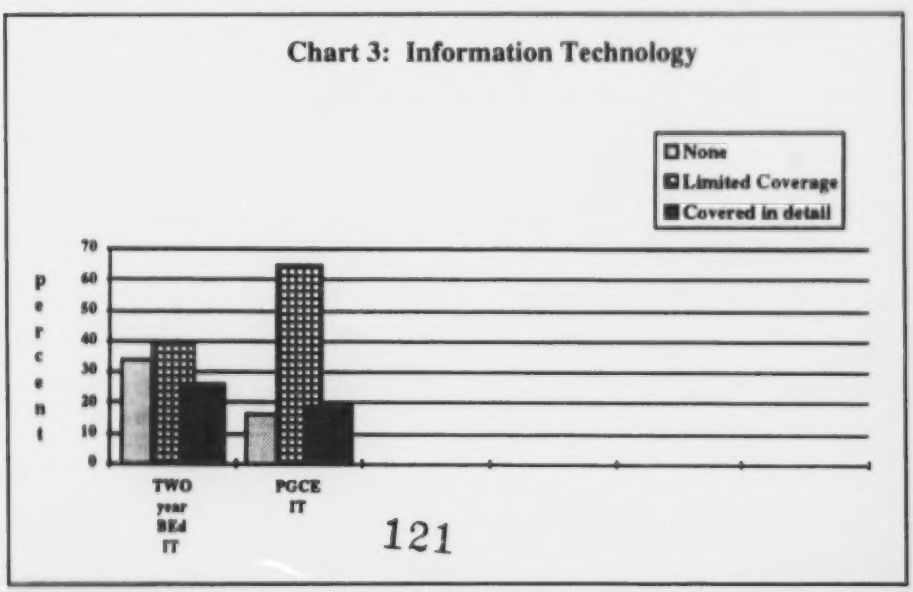
A worrying aspect is that very few students entering a two-year BEd. degree have any experience in working with plastics (6 percent) with the PGCE course better, but still a weak 26 percent. This is a popular material in schools so initial teacher education courses need to provide the necessary teaching so all students can become proficient in the use of this material. There is no doubt that textiles is under-represented as a material (*covered in detail* two-year BEd. 11 percent, with a rather weaker figure of 7 percent for PGCE), although some 33 percent of PGCE students had *limited coverage* of this material in their previous course. Students following two-year BEd. courses are in the worst position for dealing with textiles with the majority (69 percent) having no experience of using this material. This is understandable because, as stated earlier, most cohorts of students for this course have an industrial background which rarely includes textiles.

Assuming therefore that wood, metal and plastic are the most common materials used in D&T project work in schools, it is significant to record that by combining the data for these materials, the PGCE courses can boast 43 percent of students with good skills in all three materials but for two-year BEd. courses this is only 3 percent. This means that at least half the PGCE students and the majority of the two-year BEd. students need substantial teaching inputs covering working with materials. There could be problems here for PGCE courses as there is now a minimal amount of time available in the taught component of a PGCE course to cover the important health and safety (H&S) aspects of D&T. Two-year BEd. students, although weak when starting their course, do have a reasonable length of time to cover working with materials and H&S adequately.

■ Information Technology

Chart 3 shows a rather disappointing situation, with only a small number of students entering D&T teacher education courses with previous experience which can be described as competent in IT; however, the majority of PGCE students will have had some teaching input on their previous course. The small number (16 percent) of PGCE students with no previous IT coverage are probably mature students who completed degrees some years ago. The picture for the two-year BEd. courses is rather different in that while more students (26 percent) are likely to have had IT *covered in detail*, 40 percent will have had *limited*

Chart 3



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coverage and as many as one third no experience of using IT at all; again, these may be students who completed their HND/C several years ago. What is clear is that the majority of PGCE students need some 'top-up' IT teaching and a considerable number of two-year BEd. students need some basic IT skills teaching. Discussions with students revealed that many IT-literate students still face the problem of converting to a different computer system during their course of teacher training, and this can take time before they are confident to teach IT in school. Again, this could be a problem for the PGCE student with very limited time to give to learning to use new systems and software.

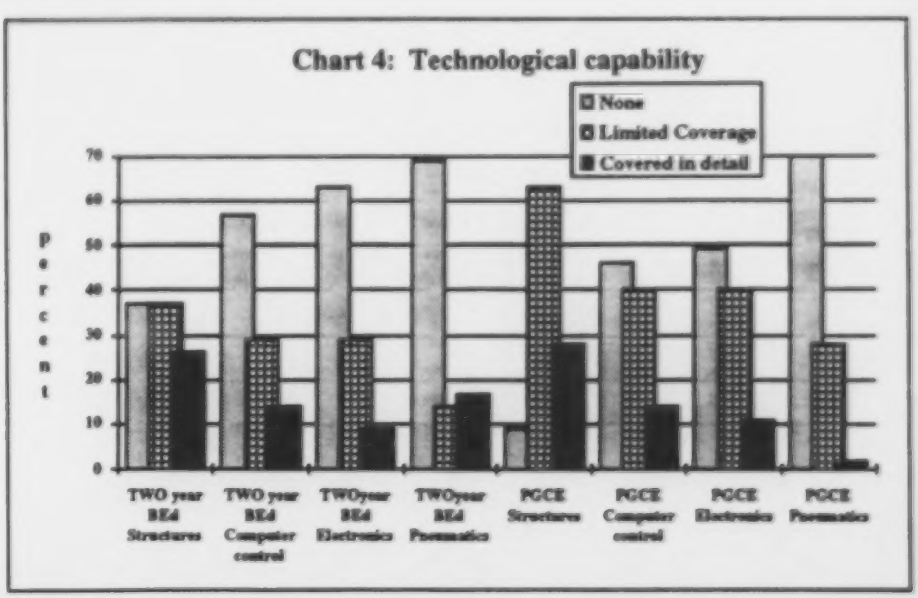
Technological capability

The picture for technological capability looks rather bleak. Compare Chart 4: Technological capability with Chart 2: Working materials and it can be seen that the *covered in detail* columns are all short on Chart 4, with the *none* columns predominating, whereas on Chart 2 the *covered in detail* columns are more in evidence. It would appear therefore that students have a greater 'working with materials' capability than technological. There are clear similarities in the coverage of technology in the different types of previous course (HND/C or degree). The *covered in detail* for structures, computer control and electronics are virtually identical for each type of course. Surprisingly, structures appears to have been covered by some students, but even this is around 25 percent only.

Computer control fares less well with only 14 percent of students having covered the topic *in detail*, and electronics is in a very poor position with a minimal 9 to 11 percent of students having had good coverage in their previous course. It would appear that degree level students have had little teaching about pneumatics (2 percent), with the HND students marginally better (17 percent), still a dismal picture. Pneumatics seems to be a technological poor relation. A rather surprising result is that many degree level students have received some *limited coverage* of structures work putting them in a reasonable position to deal with this topic in school provided they can adapt their knowledge and work at a level appropriate to schools, similarly about 40 percent of PGCE students had *limited coverage* of both electronics and computer control.

Chart 4 shows that while there are weaknesses in the PGCE students' technological profile, particularly electronics, they would appear to have had more technological teaching than the HND/C student. In the discussion about drawing capability, two methods of drawing were put together to get an overview picture; using the same analysis for technological capability the results give a dismal picture of only 3 percent of students being capable in two aspects of technology (electronics and computer control) with most combinations producing a figure of 1 percent or less.

Chart 4



Conclusions

The majority of D&T teachers would no doubt agree that it is impossible to be proficient in *all* aspects of the discipline and that an initial teacher education course should provide the student with a generalist capability plus some specialism. The newly qualified teacher would then be able to join a team of teachers and make a particular contribution to the work of a department.

The study shows that very few students entering D&T teacher training are *in alignment* with the D&T subject, most having gaps in their expertise and knowledge, and many without some of the basic skills. This puts into question the notion that such a wide range of HND/C and degree courses at present acceptable as entry qualifications form a reasonable basis for D&T teacher training. A comprehensive national study could establish the most suitable entry qualifications and provide clear recommendations on the routes into the profession. While it can be argued that diversity in the D&T teaching profession is a direct result of the numerous routes and that it has produced a creative teaching force, it has also produced a lack of agreement about the nature of D&T which people outside the profession have difficulty in understanding.

It is possible to analyse the data to obtain specific D&T weaknesses or strengths in students with certain qualifications; it is possible, for example, to see those aspects of D&T which the degree level 'product design' or HND/C engineering student needs to study on a teacher education course. It may be that changes in the content of courses traditionally seen as suitable as a precursor to D&T teacher education have changed so much that they no longer provide a useful source of D&T students.

This study has provided valuable information to both university tutors and teachers in partnership schools, particularly informing teachers that when students go out into schools in the first term of their teacher education course they are unlikely to have a comprehensive range of D&T skills which adds to their anxieties concerning organisation and management of teaching. While the information has been used in course design and development, now teachers are more closely associated with initial teacher education the findings can be of use to them when working with students on school placements. Mentors and heads of department may find the information useful when organising timetables and other tasks such as pupil shadowing. PGCE and two-year BEd. students usually have placements early in their teacher education programme but, as this study shows that the two-year BEd. students in particular have considerable gaps in their D&T expertise, negotiations between mentor and student are required to ensure that students are not expected to teach an aspect of D&T of which they have little or no knowledge. While the evidence shows that PGCE students are more capable designers and makers there are weaknesses in their technological profile and they need similar consideration, particularly during the early stages of their school experience.

As this study establishes that students entering teacher education with a degree or an HND/C have considerable gaps in their D&T skills, the time taken to plug these gaps needs to be considered. A student following a two-year BEd. course can be provided with appropriate study, and the time, to do this. PGCE students, however, have little opportunity to do this as they are now required to do 24 weeks' teaching practice during a 36-week course, leaving 12 weeks for studying both D&T *and* education. This problem must be shared between the HEIs and the partnership schools. Are teachers going to have time to teach PGCE students technological topics such as computer control, as well as dealing with the professional aspects of lesson preparation and class management? It may be that in the future two-year BEd. students will be better trained to teach D&T than the PGCE student because they have had time to build up D&T expertise. An alternative to this could be that the PGCE route into the profession produces very specialist teachers capable of delivering specific aspects of the subject only, whereas teachers trained through two-year BEd. routes are more generalist and probably more employable.

Finally, the future may be in HEIs providing specialist BA/BSc. D&T degrees followed by PGCE courses. Several institutions have done this and experience at Sheffield Hallam University indicates that this may be one way forward to overcome some of the problems of the D&T skill shortage.

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Professional Teaching Standards: what does it mean for the technology teacher?

An interview with ***Michael Jensen,*** technology facilitator at Paonia High School, Colorado, and chair of the Vocational Education Standards Committee for the National Board for Professional Teaching Standards in the USA

This article first appeared in The Technology Teacher, the journal of the International Technology Education Association

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Q *What is the National Board for Professional Teaching Standards (NBPTS)?*

A The National Board for Professional Teaching Standards is a non-profit, independent organisation whose purpose is to improve student learning in America's schools by developing a new system of advanced, voluntary certification for teachers from elementary, middle and secondary schools. The National Board will establish high and rigorous standards for what accomplished teachers should know and be able to do, as well as Board-certify teachers that can meet those standards.

Q *Will the National Board have an effect on technology teachers in the long run?*

A Yes, for the first time the field will have a rich description that can guide teacher education and ongoing professional development. National Board certification will be a way for technology teachers to be recognised for highly accomplished practice. A National Board certificate will attest that a teacher has been judged by his or her peers as one who is a highly accomplished teacher who can make sound professional judgements about students' best interests and act effectively on those judgements.

Q *What are the time lines for all this activity?*

A In general, the National Board has completed Phase I of its work, which was initial policy development. Currently, Phase II, Research & Development, is fully under way, which includes the establishment of standards in each certificate field, the design and field testing of compatible assessment exercises and the creation of an operating system that can administer for reliable and trustworthy assessments on a national scale. Phase III, Operation of National Board Certification, has begun with NBPTS offering two middle grades certificates during the 94-95 school year. Phase II should be by the end of the decade and Phase III is, of course, ongoing.

Q *You are the Chairperson of a committee working on activities for technology teachers. What are you attempting to accomplish?*

A The Vocational Education Standards Committee of the National Board is in the process of identifying what vocational teachers should know and be able to do for National Board certification — that is, defining those critical aspects of practice that distinguish the work of excellent teachers. In this process the committee is seeking to identify the aspects of practice that are common across all vocational education fields as well as important aspects of practice that distinguish highly accomplished technology education teachers from highly accomplished Agriculture Education teachers. I know that many in the profession of technology education have some difficulties in being included in a melting pot of vocational education, since technology education has been an active part of the general education curriculum. Whatever one's philosophy, the National Board is providing an opportunity for highly accomplished teachers of technology education to become Board-certified and be acknowledged for the specialty of their practice alongside highly accomplished teachers of all disciplines in education.

Q *What direction is this work taking?*

A Thus far, the committee is trying to capture a new vision in education by seeking the broad scopes of cutting-edge programs that are applied, learning oriented and integrated with all the subject areas of the school. Technology education has a uniqueness due to its broad-based approach to curriculum and the programs in application learning that interfaces well with the vision of this committee. The integration of applied learning and the emergence of vocational education subjects into the total school curriculum is being discussed in the standards work to determine what highly accomplished teachers know and are able to do. A distinctive aspect of this committee, comprised of representatives of all vocational disciplines, is identifying the commonalities among the cutting-edge programs and the differences that make us exclusive to our fields. Many of the new trends toward the educational setting such as the school-to-work transition, industry-based education, career major options, and several others are being digested in order to form a future picture for the standards work.

Q *When all this work is completed, how will technology teachers be able to prepare themselves for this?*

A I'm not sure this answer will help, but I know from being on the vocational committee that all assessment exercises must promote the National Board's vision of highly accomplished teaching, adequately assess a candidate's depth and breadth of subject matter

knowledge, examine a teacher's decision-making ability, employ rich and meaningful contexts, and engage teachers in authentic activities that are representative of teachers' real experiences and practice. I should mention to those who are new to the field of technology education that a teacher must have at least three years' teaching experience before they can apply for Board certification. Generally speaking, the National Board will provide guidelines when applying for Board certification that will outline the assessment methods and their component parts.

Q *As a technology teacher, what draws your attention to working on such a project?*

A Although technology education has had a set of standards for evaluating programs, and all related aspects of programs in place, I find that universally there is no common gauge for the teachers that can make or break a program. The National Board certification will offer teachers to show their commitment to lifelong education, reflective practice and professional development. One may even see a deeper thrust toward involvement in professional organisations in order to keep as current with curriculum change. The incentives for becoming a National Board certified teacher are tremendous as this certification will attract new teachers to education, hold on to the good ones, provide mobility between states and enhance the status of educators. Some states are providing the cost of getting Board certified and other states are granting monetary bonuses for teachers that achieve Board certification. For the highly accomplished technology teachers in our profession, and there are many, they should be afforded an opportunity to be a great teacher in the teaching profession and be granted all the privileges that accompany Board certification.

Q *Will this hinder our profession?*

A I currently see Board certification as a growth opportunity. The teaching profession as a whole will grow. I also see some states that are positioning themselves by providing incentives for teachers to become Board certified, thereby increasing the odds that they can establish a highly professional teaching force. This is speculation on my part, but we could see the same competition occurring in the field of teaching that occurs in recruiting doctors to communities, which would be better for the profession on the whole. The National Board certification will require teachers to reflect upon their practice and be active in the professional development of themselves; this aspect alone should provide a large impact upon the International Technology Education Association as a professional growth organisation. Speculatively speaking, the ITEA will see a growth in membership as highly accomplished teachers seek renewal in curriculum and practice.

Q *How can we expect to strengthen our profession as a result of this work?*

A For the first time in the history of education, we will have agreement on the essentials of exemplary practice, and the ability to hold on to and attract stronger teachers. A positive effect on the public's attention toward the demands and complexity of excellent teaching will occur and in turn provide community backing for programs. Board certification will lead to a rational and proactive means for organising and managing schools with greater autonomy, responsibility and competition for highly accomplished teachers. In particular, I would expect the profession of technology education to be inundated with highly accomplished teachers and their exemplary programs.

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News and Notes

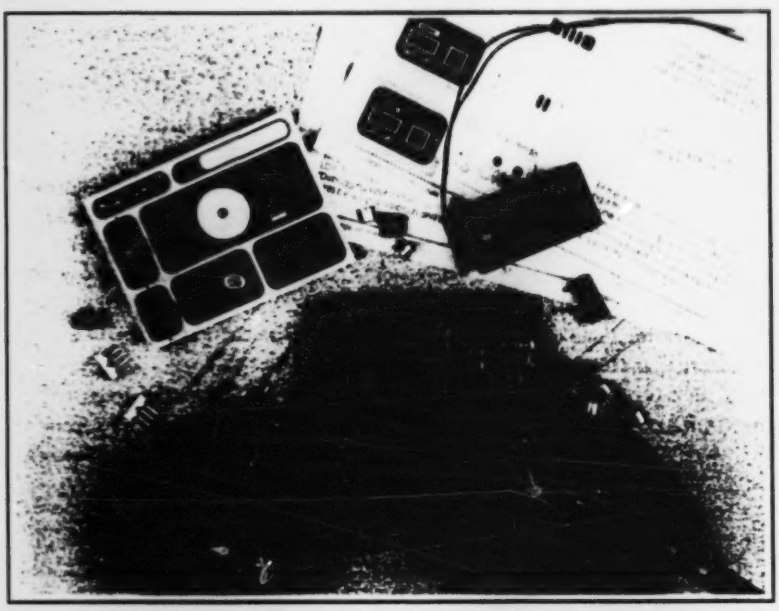
DATA Conferences on the New Order

DATA is pleased to announce a series of 22 one-day conferences on the new Orders in conjunction with SCAA. This is a major initiative, designed to ensure that DATA's members have the opportunity to discuss the new Order for Design and Technology in detail before its implementation in September. See this issue of *Design & Technology Teaching* for full details and a booking form — early application is advised as places will be limited.

Design in a Capsule

The Design Council launched Project 2045 at the end of November, inviting both children and adults to visualise the world fifty years hence. All ideas should be described or illustrated and placed in one of the Design Council's Time Capsules. A display of selected entries will be held during Future Week, 6-10th March. Although capsules should have been ordered by the end of last December, some may still be available, particularly for schools — phone the Design Council on 0171 208 2121.

The Design Council has also announced that its new Chief Executive is to be Andrew Summers, Chief Executive of the Management Charter Initiative and formerly Managing Director of RHM Foods. Wendy Powell is to continue as Director of Education and Training at the Council. *Design* magazine is set to be relaunched in the spring together with new education initiatives.



Last year's D&T Exhibition

The D&T Exhibition held in November attracted more than 11,000 visitors, and some 2,250 teachers and lecturers took part in the seminars. DATA's stand also aroused considerable interest, with Andy Breckon present throughout the duration of the Exhibition. We gained more than 160 new members and welcome them to DATA and its journals. Next year's D&T Exhibition will take place on 26–28th October — half-term week for most schools.

INSET at the V&A Museum

The V&A is holding a range of courses for primary and secondary teachers. Most of the courses are accredited by the University of London as part of its Advanced Diploma in Professional Studies. They are listed in a free booklet available from the V&A (phone 0171 938 8638).

Engineering Links

The CREST (CREativity in Science and Technology) Awards Scheme is to be linked with the Engineering Education Scheme. The EES links groups of sixth-form students with a particular company to help solve engineering problems and in future, successful EES projects will be accredited for students participating in the CREST scheme.

A further link-up is taking place between The Young Engineers for Britain and Young Engineers Club awards, open to all pupils aged 11 to 19. Cash prizes total £20,000 and there are other prizes of study tours and equipment for schools and colleges. The closing date is 31st March and details are available from local SATROs or The Engineering Council, 10 Maltravers Street, London WC2R 3ER (tel. 0171 240 7891).

A new video has also been launched describing the work of Young Engineers. Send £1.50 to cover p & p, to Young Engineers National Office, Surrey Technology Centre, Occam Road, Surrey Research Park, Guildford GU2 SYG.

The new Project Omega board from Economatics, which has a pre-drilled PCB which accepts a wide range of components for single transistor sense and response circuits such as moisture detectors and burglar alarms. A sample pack is available for £4.95 (tel. 0742 561122).

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WOCATE Resolution

The World Council of Associations for Technology Education held its conference at Banska Bystrica at the end of September, with the 107 delegates discussing 'Technology Education, Innovation and Management' and declaring that:

- The quality of life afforded by a society is directly and positively related to the extent to which its people understand, effectively use and develop new technologies in correlation with economical, social and ecological balances
- Technology education develops critical survival skills and insights for citizens in a society dominated by change and, as an essential discipline, technology must be provided at all levels of the educational systems, as well as by continuing education programmes
- Technology is a discipline in its own right and as such technology education should become an acknowledged subject for the development of human potential and capabilities beginning with education for all and extending through all levels
- In order to achieve understanding of technology, a significant insight must be established into the complex relationships found in technological situations, such as economic, scientific, environmental and practical ones, and their appropriate equilibrium.

Delegates also resolved to assume a global responsibility to develop an appropriate framework to satisfy contemporary demands related to technological education, including the need to 'empower humans through technology education to make appropriate use of technological advancements'.

Heavenly Scent

The Heavenly Scent Expo will be visiting Britain this year, starting at the Royal College of Art from 20th March to 21st April. It chronicles the history of perfume and covers raw and synthetic materials, manufacturing techniques, analysis, packaging and marketing. Details from Parker Harris on 0171 793 0373.

Events

2nd Feb.- 2nd April
Contemporary Furniture Exhibition at the Crafts Council (tel. 0171 278 7700)

2nd-4th March
Education Show, NEC, Birmingham

6th-10th March
Future Week at The Design Council, London

22nd-23rd March
Workplace Comfort Forum at RIBA, London (details from Peter Russell. tel: 01892 531830)

26-28th March
ITEA (International Technology Education Association) Conference, Nashville, Tennessee

13th April-18th June
Influence of the Natural World in Craft and Design 1900-1994 at the Crafts Council

STEW at Greenwich

Greenwich TVEI Unit is holding a Science Technology Education Workshop (STEW) on 12-13th July, with the University of Greenwich as the likely venue. In addition to being a problem-solving event for school students it is intended to provide a science and technology experience for parents and teachers too. Details are available from Greenwich TVEI Unit, c/o Kidbrooke School, Corelli Road, London SE3 8EP.

Workshop on Values

'Products and Applications — exploring value judgements in Design and Technology' is a one day workshop to be held at the University of Central England on Saturday, 11th February. Contact SCSST (tel: 0171 278 2468) for details.

IDATER 95: call for papers

This year's IDATER Conference will take place at the University of Loughborough on 4th-6th September. There is a call for papers related to D&T education at all levels. Further information is available from:
Mrs E. Havard-Williams, Dept of D&T, Loughborough University of Technology, Loughborough LE11 3TU.

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Book Reviews

Sensors & Security, Flashing Lights and Making Noises
Cudworth Teaching Aids, £29.95 each
Reviewed by Dr Rowland Dye

Cudworth have divided KS3/4 Electronics into separate modules entitled Sensors & Security, Flashing Lights and Making Noises. Further titles such as Power Supplies are also promised soon. Each module comprises a 15-minute video and a 23-page booklet which is photocopiable within the institution.

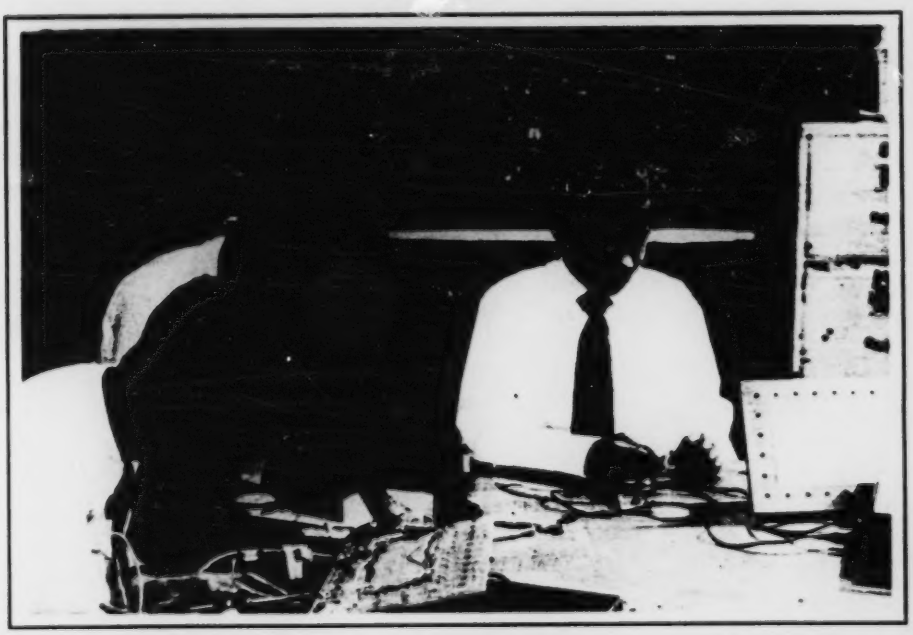
Each module is intended to be largely self contained. The booklets start with an eight page core of basic information covering resistor codes, symbols, soldering, Ohm's law and capacitors. Between a dozen and two dozen circuits are then described together with further components as necessary. Finally a range of possible pupil projects is listed.

Sensors & Security contains transistor switching circuits using the LDR, thermistor, moisture sensor as inputs and the bulb, LED, relay, solenoid and counter as outputs. These circuits are then extended using the 741 op amp. The video introduces examples of automatic sensors in everyday life, with pupils describing a moisture detector, automatic fan and door and a heater system for a greenhouse.

Flashing Lights has two-transistor astable circuits shown in various configurations, then moves on to the 555 timer astable. The outputs are developed from bulbs and LEDs to the light chaser, counters and 7-segment displays. The video shows pupils building fast-food advertising signs with LEDs or bulbs. A separate section shows design and production of PCBs.

Making Noises also contains two-transistor astable circuits in various configurations to produce sounds via a speaker, and then moves on to the 555 timer astable. These are developed into a two-tone device which can be pulsed on and off or controlled with a time delay, light sensor, heat sensor or music keyboard. The video shows pupils constructing a variety of board games with special sound-effects.

Videos are a useful medium for explaining principles and points of detail which would be lost in the crowded classroom. The packs contain a well organised core of skills and information followed by libraries of circuits which would enable students to progress at their own rate, but I found myself frustrated by the attempt to cover too much in a limited space. There are some curious omissions and some irritating errors. I would have preferred basic skills to be treated in their own module and would have appreciated some background information on components. I look forward to a revised edition which will support busy and hard-pressed teachers looking for teaching resources in this field.



Scene from one of the Cudworth Vidoes

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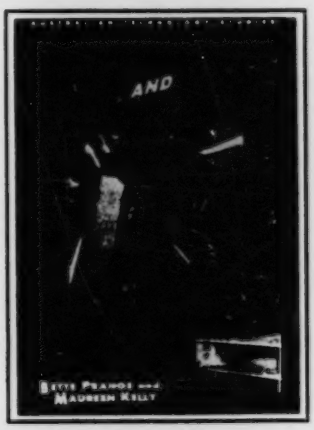
Metals and Technology
Ray Stevens
Cambridge University Press, £7.95
Reviewed by R.M. Gawel

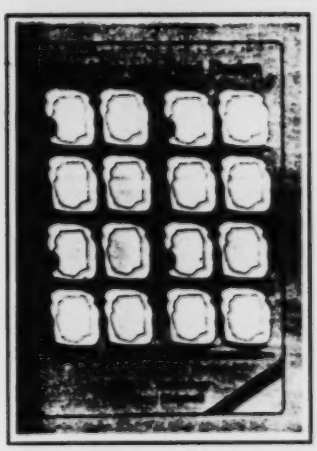
Can an Australian textbook offer anything to teachers in the UK? Certainly Ray Stevens tries to cover a wide ranging theme, dividing his book into ten chapters dealing with the familiar topics.

The more densely technical aspects are treated in detail — probably greater detail than is strictly necessary. The design side, structures and tools and processes are more sketchy although there are useful checklists and some valuable hints for pupils conducting research. I noted that although the case studies cover work by both a boy and a girl, the former was much more comprehensive, which is not quite what we've come to expect.

Naturally, there is some Australian emphasis in the book, and there may some value in comparing British and Australian practice through this book, but the overall feel was definitely old fashioned. The illustrations are all monochrome and most pupils expect something a bit more sophisticated. There are plus points, however: the summary panels and many of the questions and tasks in each chapter, for example.

Metals and Technology covers one area of National Curriculum technology and that in a patchy way compared with many textbooks, yet it may be a justified addition to the bookshelf in providing an Australian view of school technology.





Wood and Technology
Betty Prange and Maureen Kelly
Cambridge University Press, £7.95
Reviewed by R.M. Gawel

This book suffers from the same deficiencies as its companion by Ray Stevens, but equally, it also shares its strengths. Although the section on tools is comprehensive, not all tools are illustrated or their use explained in detail, and the design section tries to compress the design process, drawing methods, materials and joining methods into one too-short chapter.

In contrast, other chapters offer interesting detail and provide an Australian aspect of government attempts to regulate the timber industry. Although its topics have been well covered in other textbooks, this has something to offer — and not just the positive role model given by two female authors. It would be valuable as a source book, particularly in studying timber as a question of global significance.

Nutrition and Food Design
Jenny Ridgewell
Ridgewell Press, £22.50
Reviewed by Anne Gilbert

This is another useful food-based publication from Jenny Ridgewell, aimed at key stages 3 and 4. It is part of a series and due to its publication date is linked with the old technology curriculum, but could be used with the new curriculum too.

Its cost is high as can be expected of material that is photocopiable, but unlike some past publications, it includes fact sheets as well as resource task sheets, allowing discrimination in the use of the material by teachers. The contents draw on a wide range of resources already in existence.

The level of language is pupil friendly, with simple cartoon-type illustrations, a range of data presentation methods and flow charts and a useful resources list. The tasks set are general and familiar and suitable for use with pupils. Nutritional information is stressed and there are links with many of the nutritional databases used in schools, using DRVs and RNIs (also explained in the glossary).

The tasks are aimed primarily at KS3 pupils, but with some expansion could be used at KS4. Contents are based on the main nutrients needed as well as dietary guidelines, in line with the latest recommendations; there are also sections on food processing and special dietary needs.

This publication would be a useful addition to any food technology resource area. As with any publication of this kind, it doesn't offer all the answers but the style and content can be easily adapted for use with pupils.

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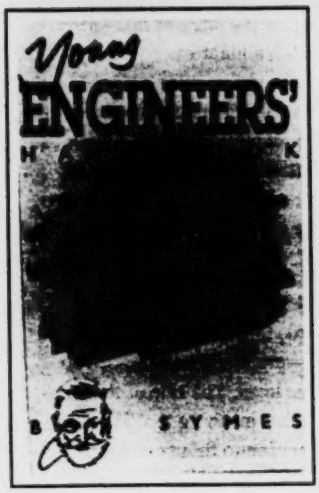

Corporate Identity & Package Design
Giovanni Brunazzi
Art Poligrafiche Europe, £50.00
Reviewed by G. Asquith

This is a hardback, top of the range reference book of 190 pages, having both Italian and English text — the latter being at times a less than accurate translation. It is, however, a very detailed publication divided into four sections: packaging, communication, case histories, a guide to environmental packaging and an A to Z of package design terminology.

The book is well illustrated with very high quality photographs. The case histories are most informative and could be an excellent reference for students. Sections 3 and 4 make me wonder how I have managed without this information for so long.

This is an excellent publication, but you should see the book before purchase as the price is high.

Young Engineers Handbook
Bob Symes
Bright Books Ltd, £1.99
Reviewed by John Durrell

You may already be familiar with Bob Symes, who has been involved in a range of media presentations promoting technology. He is also one of the presenters of Tomorrow's World. The format of the book is A5 and it is divided into nine sections, the last two being a glossary and useful addresses.

The first section is an introduction directed at young engineers, and the middle sections deal with a range of topics including power, communication, heating and ventilation, movement, holding things together and cost counting. The book appears to have been written almost in the same style as the Boys' Own books of the 1940s although, to be fair to Bob Symes, girls are also shown joining in the activities.

It gives a taste of various technological activities, and although it seems to want to get

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young people interested in the construction of technological projects, it appears to lack the details essential to completing a project. For example, a circuit diagram for an intercom is given with no values for the components; it fails to give advice on how to build the circuit, save to say that pupils could ask the shop assistant for advice.

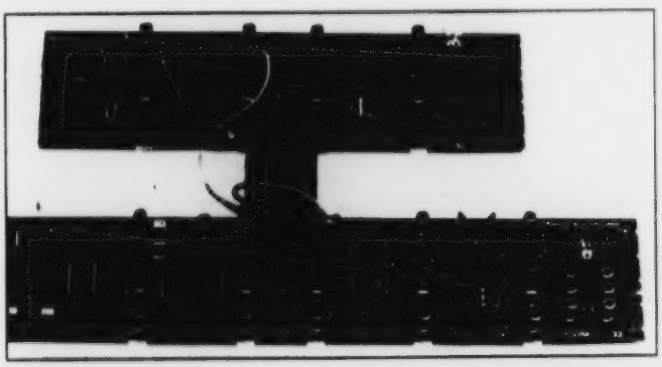
There is a section on construction which is divided into permanent and semi-permanent joining of materials and, for good measure, a section on glues. The book claims to give only outline information and this is the case: some of the projects would require a good deal of further research. Within a D&T context, some of the ideas might trigger potential projects, but pupils would need to put more 'flesh on the bones'. As a taster the book works, but as a class resource it is less successful.

Spreading the Word
SCSST, £25.50
Reviewed by David Foster

This pack contains a videotape of some twelve minutes' duration, and two booklets, Spreading the Word and one on the story of margarine. The pack deals with a great variety of topics and following on from the video outlines many aspects of project work that could be provoked. Essentially, in my experience, short videos can add to the content and outcome of a lesson, whilst videos of twenty or more minutes can have the opposite effect.

Even from the point of view of KS3, there is still some mileage in the materials. The technology process remains the same and it is obvious that the work could be extended for pupils beyond this level. The title of the pack therefore has another meaning too. The pack certainly has relevance to those colleagues delivering the IT element of the curriculum when it explains the use of barcodes and stock control. The support materials booklet is excellent, even though black and white only.

There is a series of related titles and further video packs, text packs and multimedia packs. They deal with a wide range of topics and could come highly recommended if they are of the same quality.



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TESTBED is the name for technology resources from UNILAB

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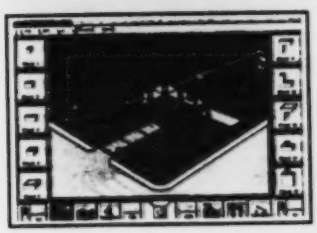
Software Reviews

KidCAD
Davidson & Associates
Distributed by ABLAC Learning Works
PC with Windows: £39.95 (single user)
£79.95 (up to five users)
Reviewed by John Hanson

I was very pleased with this program and overall it proved to be worthwhile. I have used several of these Lego-style CAD programs on different computers, and this is a very good one. The icons are very attractive, there is a good range of 'bricks' and other components and the backgrounds you build on are very attractive. It has all the necessary tools and facilities for changing position and eye level, painting, zooming, rotating and showing in 3D. Of all these, it was the wide range of ten demolition tools with some of the best icons I have ever seen which really pleased me. It slowed down a bit as the drawings became complex but that is only to be expected.

It requires a PC with Windows 3.1 (enhanced mode) or above, at least a 386 processor with 4Mb memory, 9Mb of hard disc space and a sound card is recommended. I think this is a very high specification for most schools or individuals to meet and it took me a little while to find a computer that would load the program. I was, however, delighted that the program was bright enough to check the computer before it loaded and would not load unless its requirements were met. It may therefore have a limited market, likely to be used by children of computer professionals with up-to-date equipment, who want their children to be confident and competent in design and whose children are not put off by their parents pushing them off the computer in order to play with the software themselves. It would also be useful to schools doing technology with young children if they have lots of PCs available. Sadly, there are not many of them around.



Nevertheless, the manual is good and the whole package is attractive. At about £40 it is also reasonably priced.

Noddy's Big Adventure
Jumping Bean Co. Ltd
Distributed by TTS
Acorn: £26, PC: £30
Reviewed by John Hanson

You can imagine my reaction when I received this piece of software to review but I dutifully opened it up and ran it. I was delighted with the free Noddy badge and quite pleased with the software. It is available for Acorn and PC and the PC version I used installed itself quite easily. It asked me a few odd questions during the set-up program such as 'How fast do you want the game to run on a scale of 0 to 255?', to which I had to guess an answer.

The program consists of a word processor, seven games and four linking scenes which allow you to move around the program. The word processor is in an attractive style similar to others aimed at very young children, with simple icons, sample stories and three levels which allow a range from a great deal of adult help to a self-sufficient simple word processor. The games include Kitchen Fun, which involves selecting ingredients to produce a food, Noddy's Scales (a number game), Tricky Trees and Can You Find Me? (memory games). Bert's Scrapbook and Beach Sorter are sorting games and Picnic Attack is a nice shoot 'em up. These are all similar to other infant games but with a technology slant. The linking screens are interesting and both these and the games are supported by stories in the instruction manual.

The graphics are good, the instruction manual excellent and the overall package attractive, helpful and useful. This is certainly of better quality than the children's educational games my children played more than ten years ago. I am a bit worried by the 'Conforms to the National Curriculum' claim as I think this plays on parents' insecurities, but overall this is an excellent package and at the price it is a good buy.

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GEC Regional Conferences supported by DATA

A major initiative from DATA to launch the new Orders for Design & Technology and its own guidance materials

Principal Speaker will be **Andy Breckon** Chief Executive of DATA with representatives from SCAA/ACAC. These conferences will include detailed explanation of the new Orders, support material and the DATA guidance materials, as well as opportunities to discuss strategies and see new resources.

Primary Conferences (9.30-3.30pm)	**Secondary Conferences** (9.30am -3.30pm)
9 March - Taunton - Forte Posthouse	10 March - Taunton - Forte Posthouse
13 March - Winchester - Forte Crest	14 March - Winchester - Forte Crest
15 March - Bexley Heath - Swallow	16 March - Bexley Heath - Swallow
21 March - London - M.Robert Hounslow	22 March - London - M.Robert Hounslow
23 March - Cambridge - Univ. Arms	24 March - Cambridge - Univ. Arms
28 March - Nottingham - Rutland Sq.	29 March - Nottingham - Rutland Sq.
30 March - Leeds - Forte Crest Hotel	31 March - Leeds - Forte Crest Hotel
4 April - Newcastle - Dryden Conf. Ctr.	5 April - Newcastle - Dryden Conf.Ctr.
25 April - Manchester - Cresta Court	26 April - Manchester - Cresta Court
1 May - Birmingham -St Johns Solihull	2 May - Birmingham -St Johns Solihull
3 May - Swansea - Marriott Hotel	4 May - Swansea - Marriott Hotel

Conference Fee (including lunch and DATA guidance materials) **£40 DATA members** **£55 Non DATA members**

The DATA guidance materials written with the support of the **DFE** are in 2 packs, key stage 1 & 2 and key stage 3, and build coherently on the SCAA support material . The looseleaf packs (approx 80 pages with poster) give details of planning the implementation of the new Orders in design and technology in each key stage, and include examples of schemes of work, timetabling guidance and monitoring schedules. A major part of the packs is a series of units of work that cover all the programmes of study, giving ideas for activities and associated resources. These packs are available from 9 March.

DATA guidance materials (Reduced rate for multiple purchases) **£7.50 including p&p DATA members** **£13.50 including p&p Non DATA members**

Further details of Conferences (including programme) and guidance materials from DATA

Return to DATA 16 Wellesbourne House, Walton Road, Wellesbourne, Warwickshire. CV35 9JB
Bookings Tel. 0789 470007. Fax . 0789 841955

Name .....Institution.....

Address.....

.....Tel/Fax No.....

Conference venue.....Date of conference..... No. of Places.....

KS 1&2 Guidance material Only ☐
KS 3 Guidance material Only ☐
Number of Packs ☐

Payment by invoice ☐ DATA member ☐
Payment by Cheque ☐ Seeking DATA membership ☐

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Current DATA Publications

Good Technology Guide

Primary vol. ISBN 1898788 006 (members £8.95) £9.95
Secondary vol. ISBN 1898788 014 (members £17.95) £19.95
An authoritative guide to help you plan and deliver design and technology. Over 300 resources categorised in such a way that you can match any changes in the technological course proposals. Lists books, software, videos, equipment, tools and places to visit. Easy to use — well structured and detailed, helping you benefit from the experience of others. Ensures that the right resource is purchased for the right activity.

DITT Pack

IT in D&T pack £19.50
The DITT pack is a set of adaptable classroom resources aimed at encouraging the use of IT within the framework of National Curriculum D&T. The pack is interactive and contains a wide range of tasks, each produced on separate photocopiable sheets and featuring basic IT skills. By selecting from these materials, teachers can build a programme of activities to suit pupils of widely differing needs and abilities.

All the activities have been written by teachers for practical use in the classroom. Each is clearly presented and makes use of familiar materials and equipment. All that is new is the incorporation of IT. The materials can be used with a whole class or a small group of individual pupils, and are suitable for a wide age-range, but most specifically Key Stage 3.

A Survey of Capitation Allowances for D&T in Primary and Secondary Schools

DATA Research Paper No. 1 £3.50
Looks at the implementation of D&T in the National Curriculum, specifically at the criteria for allocating capitation allowances and the variations which exist. Directly associated issues which affect the satisfactory implementation of design and technology are also addressed.

A Survey of the Qualifications and Training needs of D&T Teachers in Secondary Schools

DATA Research Paper No. 2 £7.50
This is a report on the training and qualifications of teachers of Design and Technology in secondary schools in England and Wales, based on a survey of several hundred schools. The survey was carried out to examine the relationship between the qualifications of Design and Technology teachers in secondary schools and the elements of D&T they were currently teaching.

Imagineering

ISBN 0 948080 84 1 £3.50
Imagineering presents an exciting way of stimulating young people to develop creative ideas in design and technology and to go on to put them into practice. The ideas developed in it are the result of a collaborative project between schools and manufacturing companies in Keighley.

ORDER FORM
DATA Publications: 16 Wellesbourne House, Walton Road, Wellesbourne, CV35 9JB Tel: 0789 470007

Quantity	Title	Price each	Total
		Full Total (includes P&P)	

Name

Address

Send cheque/order together with order form. Prices include p&p.

■ Joining DATA

DATA is the professional association for all those involved in design and technology education.

For £25 membership you will receive each year six issues of DATANews, three issues of PrimaryDATA, three issues of Design & Technology Teaching, up to three special interest publications, 10% discount on all educational publications, liability insurance — and more! Write for further details to the address above.

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Guidance to Contributors

In order to provide some guidance for those who may wish to send in contributions, but are not sure if what they have is appropriate, an outline of the general requirements of articles for the journal and the particular feature of the sections are outlined below.

General

In general all contributions should be double line spaced where possible.

We can not take responsibility for those which may go astray in the post so please retain a copy yourself.

Articles can be of varying length and should identify with a particular audience e.g. teachers, HE-researchers or students, developers.

Inclusion of the following, where appropriate, would be most helpful to the editor and the reader:

- The name and title of author together with a contact and telephone number for the editor. In addition if you would welcome contact from readers please include a correspondence address.
- Full reference: title, author or editor, year, publisher. For Journals the title, volume no. and title of article.
- Illustrations; if taken from somewhere else please state if permission to reproduce has been gained, if not then from whom it may be gained. Other illustrations such as photos, planning sheets, pupils' work, etc. should be as clear as possible and enhance the article.
- A short paragraph, about 100 words, at the beginning of the article which describes what the article is about; follow by paragraphs which have sub-headings.

Contributions are welcomed to particular sections:

Personal perspectives

These should be short, about 1000 words, giving your views on D&T issues.

Letters

Letters too should be short and punchy. If in response to an article or letter, etc. this should be clearly referenced.

Resources

Reviews on how resources are used in the classroom to support and enhance D&T. These may include equipment, software, a curriculum packs, people and other organisations, etc.

News and notes

Information on conferences, events, initiatives, situations vacant etc.

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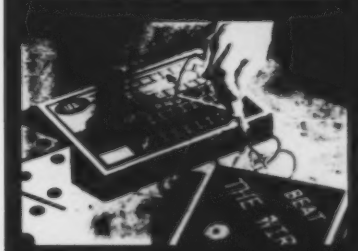
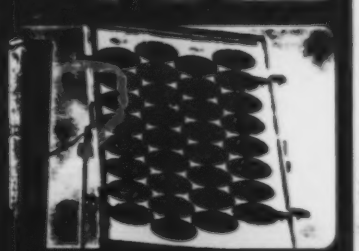
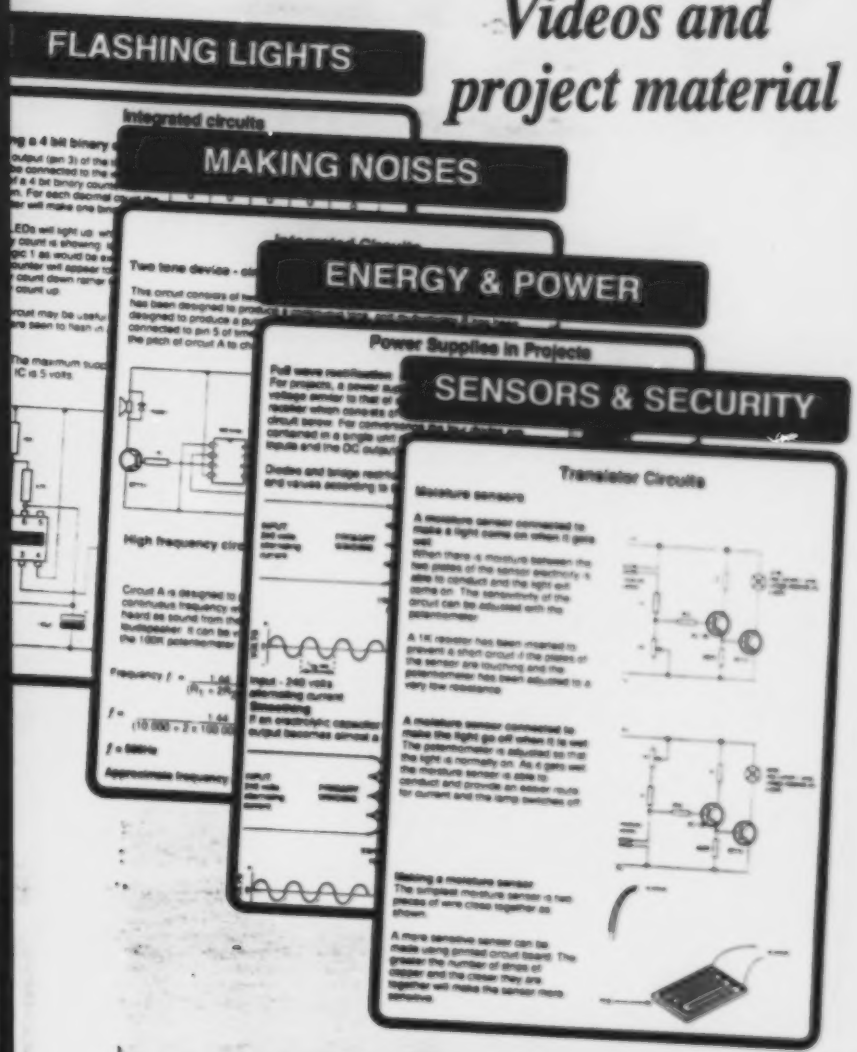
Design and Technology Videos and project material

Control and Electronics





Sample 10 minute video featuring all four titles



Covering the content of GCSE syllabuses and also further education, videos, project notes and circuits are suitable for a wide age range and are contained within a single resource.

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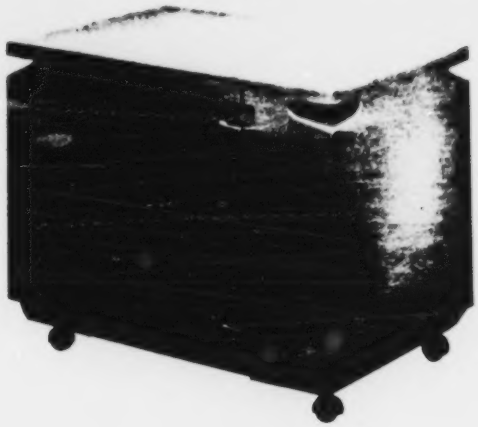

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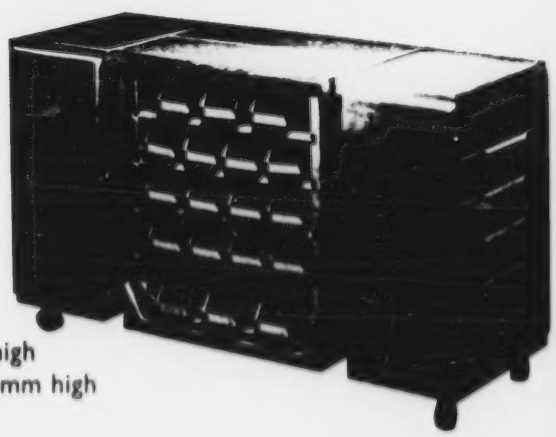

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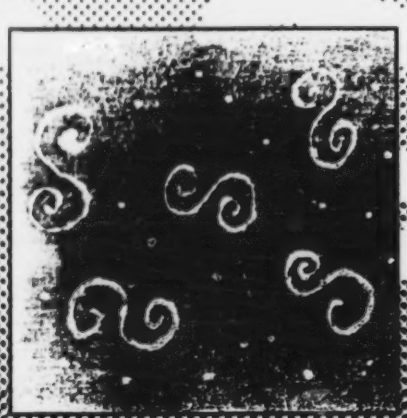

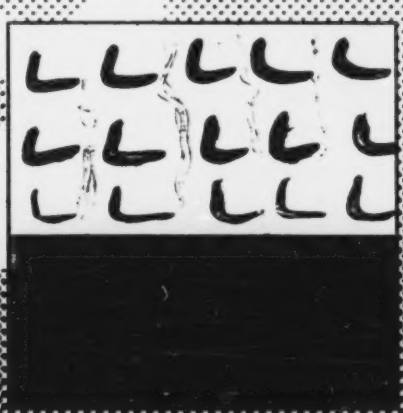

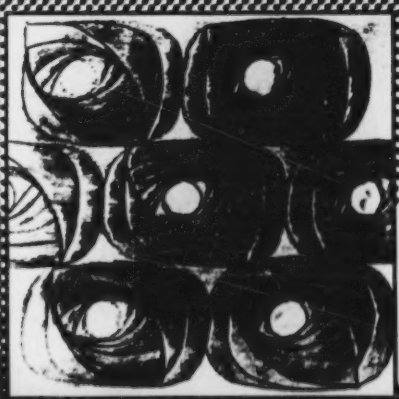

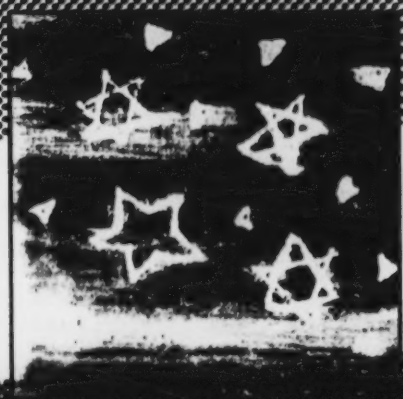

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The Design & Technology Association

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GCSE CONFERENCES

These conferences are designed to provide an opportunity for teachers to analyse GCSE syllabuses meeting the Design and Technology criteria that are on offer for September 1996. To make a flexible programme the morning has been broken down into two plenary sessions where Examination Groups will make 20-minute overview presentations. Running alongside them in the morning will be 50-minute seminars which you can attend, to gain further details and ask questions. In the afternoon there will be two more rounds of seminars arranged in a different format. The conference will allow delegates to attend up to four seminars provided by the examination groups, or three seminars and a plenary, or two seminars plus two plenary sessions.

The conference papers will include a free copy of the DATA Guide to GCSE in D&T (this paper will cost £9.50 to DATA members and £15.50 to non-members).

The conference cost is £55.00 to DATA members and £70.00 to non-members and includes conference papers and lunch. Conferences will commence at 9.00 am and finish at approximately 3.30 pm.

Tuesday 10th October 1995	**- Imperial Swallow Hotel**	**NEWCASTLE-UPON-TYNE**
Wednesday 11th October 1995	**- The Swallow Hotel**	**WAKEFIELD**
Thursday 12th October 1995	**- The Swallow Trafalgar Hotel**	**PRESTON**
Tuesday 17th October 1995	**- The Swallow Hotel**	**BEXLEY HEATH**
Wednesday 18th October 1995	**- Parkside Hotel**	**BRISTOL**
Thursday 19th October 1995	**- St John's Swallow Hotel**	**SOLIHULL**

Closing date for applications: 20th September 1995 One delegate per form, please copy for multiple requests

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I would like to become a DATA member. Please invoice my conference fee at members' rates + membership fee: _____
Individual member £25.00. Overseas £40.00. Students £10.00. Institutional (member equivalents) £25 (1); £40 (2); £60 (3); £100 (6)

Design & Technology Teaching

A journal of new approaches

Volume 27 Number 3 1995

A journal of DATA, The Design and Technology Association

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Design & Technology Teaching is published three times a year — Winter, Spring and Summer.

The journal focuses on developments in Design and Technology across all phases of education. It provides a forum for sharing and developing expertise in all the contributing areas of design and technology: art and design, business studies, CDT, home economics and information technology. It covers news, information, reviews of materials and resources and case studies of good practice. Design & Technology Teaching is distributed free of charge to members of The Design & Technology Association.

Contributions Contributions are welcomed, and prospective authors are invited to send a synopsis of their article to the Editor, Design & Technology Teaching, DATA, 16 Wellesbourne House, Walton Road, Wellesbourne, Warwickshire CV35 9JB.

Reviews Books and resources submitted for review should be sent to the Editor, at the address above.

Subsriptions and DATA Membership *Design & Technology Teaching* is sent free of charge to DATA members, who also receive three issues of *PrimaryDATA* and six issues of DATAnews each year. Annual membership for individuals costs £25 (UK) and £40 (overseas). To join DATA, or to find out more details on membership, contact Suzanne Elphick at DATA, 16 Wellesbourne House, Walton Road, Wellesbourne, Warwickshire CV35 9JB (Tel: 01789 470007 Fax: 01789 841955).

If you wish to receive *Design & Technology Teaching* alone, the rates are £20.50 in the UK (£19.50 if paid by bankers' order) and £23.50 overseas. Contact Barbara Wiggins, Trentham Books Ltd, Westview House, 734 London Road, Oakhill, Stoke-on-Trent, Staffordshire ST4 5NP. (Tel: 01782 745567 Fax: 01782 745553).

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Cover picture:
Some ways of using a computer to create designs for textiles — see Margaret Beith's article on page 34).

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Editorial

John Eggleston

The Design and Technology Association has demonstrated its role and function with dramatic effect in the past four months. A series of conferences on the new National Curriculum has been held in venues up and down England and Wales, attended by many hundreds of teachers, both members and non-members. New handbooks of curriculum guidance have been prepared for primary and secondary schools, along with charts and diagrams, to help teachers to interpret and deliver the new orders. The response has left DATA in no doubt that our Association 'has got it right' and has provided a major service to the profession. And, alongside the intensive work in the field, the political power of DATA has increased sharply and almost no new initiative in our field is now undertaken without consultation with our Association.

This issue of *Design & Technology Teaching* reflects this heightened level of activity and significance with a broad spectrum of ideas to enhance practice and to stimulate discussion. Articles range from primary through secondary to teacher training programmes, food and textiles to wood and metal and information technology and electronics, curriculum assessment to policies and ideology.

Read from cover to cover this issue of *Design & Technology Teaching* is a salutary reminder of the immense breadth of Design and Technology. If we were inventing it now, the task would be abandoned as 'mission impossible'. But the subject exists and makes a central contribution to the curriculum in many countries — as this issue so impressively shows. The mission of DATA and *Design & Technology Teaching* is to ensure that it continues to do so with ever increasing strength and support.

SPECIAL OFFER

■ **Back numbers of *Design & Technology Teaching***

The publishers of *Design & Technology Teaching*, Trentham Books, offer all readers the chance to buy any back numbers at the reduced price of £2. (Yes, right back to the early years!). Just write in and say what issues you want — Spring, Summer or Autumn indicating the year and enclose payment or Official Order. We can also supply, at £2 each, *Delivering the Technology Curriculum, Nos. 1, 2, 3* and *4*.

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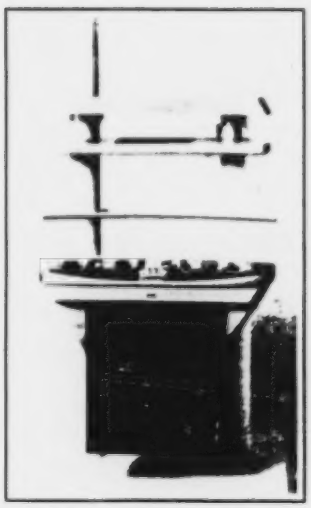
News and Notes



The Central Ergonomic Cooker for the year 2010, winner in a design project held at UCE and sponsored by Parkinson Cowan. Pillar-mounted and adjustable in height, it features an eye-level grill, extractor fans, an oven which allows users to select its size, and a computer for pre-programmed cooking.

BTEC courses now on email

The new specifications for GNVQs such as Manufacturing and Art and Design are now available on the Internet and via electronic data interchange (EDI). The specifications have been updated and contain new sections on guidance for tutors. BTEC's email address is: btecmar@btecmar.demon.co.uk and the specifications can be accessed on the World Wide Web service on the Internet at: http://www.demon.co.uk/btec.

Designing an allergen-free home

Perhaps with the increase in asthma in mind, the Ideal Home Show boasted a 'low allergen' house. Its aim was to reduce humidity and prevent the growth of the mould on which the dust mite feeds and to limit conventional dust-traps. It was fitted with a mechanical ventilation and heat recovery system with a heat pump and dehumidifier which changes all the air in the house once every hour. The floors are wooden and where carpeted have vinyl cushion flooring, and soft furnishings are avoided unless they can be washed at 55°C.

The kitchen has flush-fitted units from floor to ceiling and the surfaces are covered with non-porous Corian which is mould-resistant. Both kitchen and bathroom (notorious 'damp' areas) are finished with non-porous ceramic tiles and the bathroom even has flush-fitted mirrors with demisting devices behind them to reduce condensation.

Parents and schools will be relieved to learn that apparently any building can become low in allergens by 'thoughtful planning, making sensible choices when changing furnishings or decor and an efficient approach to cleaning'.

Bicycle Pack passes a milestone

The Ciba Teacher Development Programme for Science and Technology has now held courses for 2,000 primary teachers. Launched in March last year with the *Bicycle Pack*, the programme has set a target of training 10,000 primary teachers by the end of 1996. Course details are available from Sylvia Innes at SCSST on 0171 278 2468.

Health and Safety

The Health & Safety Commission has published guidance on safety management in schools. One in 20 accidents reported to the HSE is from a school, and the numbers have increased over the last three years. Some 4,477 school students were seriously injured in the year 1993/4, together with 3,815 school employees. Accidents range from broken limbs (often sports-related) to severe burns and scaldings, which are more likely to be of concern to teachers of D&T.

Called *Managing Health and Safety in Schools*, it costs £5.95 from HSE Books, PO Box 1999, Sudbury, Suffolk CO10 6FS.

Design magazine relaunched

The Design Council has relaunched the magazine *Design*. It is now a quarterly journal and, as you might expect, its design is attractive. Free copies are being sent to 15,000 policy-makers and informers in the field of design (DATA included), but the rest of us can subscribe for £20.00 a year. Details from ETP Ltd, Halford House, Coval Lane, Chelmsford CM1 1XZ or from the Design Council.

Design Courses

The new edition of *Design Courses* 1995-96, published by Trotman and the Design Council, is now available at £9.50. It lists pre-foundation, foundation, BTEC and degree courses, together with engineering design and teacher education courses, throughout the UK. Packed with useful information, the only omission is a comprehensive index along the lines of those in the UCAS and ADAR handbooks.

Snippets

- Philips, makers of the CD-i system, have teamed up with Esso so that schools can save up Tiger Tokens and exchange them for audio-visual equipment. The initiative is called 'Pump up the Knowledge' and both new and old tokens are valid. Phone the Helpline (0171 976 6699) for a catalogue and details.
- Harris Looms has produced a new upgrade for its Weave software so it will now run on the Acorn RISC-PC. The software enables students to design, amend and store weave patterns on screen before outputting to an electronically controlled

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Harris Loom. Details from Emmerich (Berlon) Ltd, tel. 01233 622684.

- EFM has launched a new torch for jewellery making which uses compressed air and gas rather than the traditional mouth-operated torches. This is in response to jewellery students from UCE who were concerned by the health risks involved in having to share equipment. Details from EFM Flamefast on 0161 793 9333.
- BNF has launched a unit for 11-16-year-olds of *Food — a fact of life*. Called Energy and Nutrients, it covers ten topics, materials for teachers and pupils, two videos and EatMeter, a dietary analysis program. The pack is on special offer (£40) to schools until 1st July, and will be £50 thereafter. EatMeter costs £13.50. Contact BNF on 0171 404 6504 for details.
- The British Diabetic Association has launched a free pack for schools on caring for pupils with diabetes and a teaching pack for KS4 with science experiments and worksheets (costing £39.95 plus VAT). Contact BDA on 0171 323 1531 for details.

■ EIDCT Benevolent Fund

Former members of EIDCT (the Educational Institute of Design, Craft and Technology) may wish to know that its benevolent fund is still in existence, to benefit ex-members, their families and dependents. Donations may be sent to the Secretary, E. Heaseman, at 318 Victoria Drive, Eastbourne, E. Sussex BN20 8XS, tel. 01323 727161.

■ Events

Until July 2
RSA Student Design Awards exhibition at Crossley Gallery, Halifax

Until Sept 3
'Muppets, Monsters and Magic' exhibition at MOMI, South Bank, showing the construction of the Muppets and other famous puppets

June 9-10
Great Northern National Curriculum Exhibition, Huddersfield

June 24
National Nutrition Education Conference at the New Connaught Rooms, Covent Garden. Contact BNF on 0171 404 6504

July 6-7
DATA Annual Conference and AGM, Barnwood, Gloucester

July 17-21
TEP Summer School (tel. 0171 240 7891 for details)

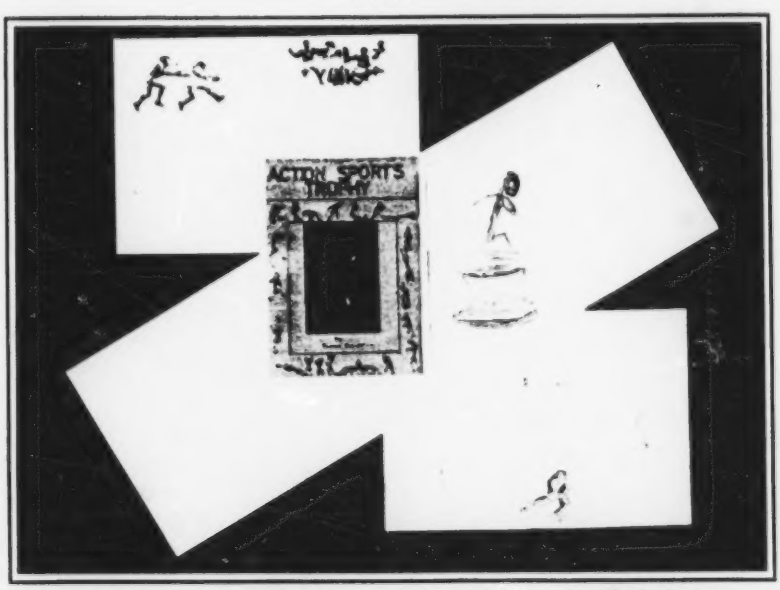
Aug 21-22
'The Challenge of Complexity', International Conference on Design Management at UIAH, Helsinki

Sept 4-6
IDATER Conference, Loughborough University

Oct 10-19
DATA regional GCSE Conferences (phone DATA for details)

Oct 26-28
D&T Exhibition, NEC, Birmingham

8-11 Jan
'Technology education for a changing future: theory, policy and practice' conference in Jerusalem



Action Sports Trophy, by Thomas Homer, winner in the 11-14 age group in the TSB's Design for Athletics competition held in February. The sporting figure is made from steel and sits on a turned wooden base.

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Technology — a subject in turmoil?

D.T. Lawson

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The new Order has been broadly welcomed, but can D&T breathe a sigh of relief now?

Why is it difficult to find a true consensus of opinions as to the direction technology should take within the school curriculum? Why did the National Curriculum initially destroy so much good technology work in schools? Will the new Orders allow enough scope for teachers to pick up the pieces?

In educational terms technology is still a very new subject, having arrived on the curriculum scene during the early eighties, and having been fought over by both the science and CDT areas. Due to the increasing burden on the science curriculum and the lack of appropriate space for the realisation aspects of technology, science departments gradually gave way to the advancing thrust of the CDT departments, many by then already well on their way to building their second BBC buggy!

This development caused a problem in itself by amalgamating all the different specialisms found in most schools. Most headteachers (and indeed ministers for education), solved this very easily: they threw everybody together and called them The Technology Department. Suddenly, teachers who had specialised in a specific area for many years could now teach computer control, electronics or food — at least, according to the timetable.

There are many aspects of D&T which are misunderstood by those who are not familiar with this area of the curriculum or the pedagogy of technology teaching. This is quite different in a number of aspects from other classroom-based teaching. How many times has someone whose teaching consists of setting the same task to the whole class hinted that you lack classroom control? Technology rooms have to allow freedom, breed confidence and decision-making skills and give space for individuality, flair and creativity.

The new Orders

The new Orders have been well received and will allow for proper technology to find its way back into our schools. For too long technology has been shackled by academics whose emphasis was on paperwork and 'process'. Students do have to experience the process, they have to be part of the process, but they also need to obtain the necessary skills and experiences. Technology is a very careful balancing act between the old and the new: if there is no foundation of skills, what can you build on?

I am concerned about the complete separation of IT from D&T — not that I disagree with the separation as such — but there is a danger that IT will disappear from our workshops, at a time when manufacturing depends more and more on it. I have concern too about the temporary relaxation of Key Stage 4. This is to provide time to allow schools to gear up and to allocate part of their budget on the necessary resources and INSET. But will this take place? Already, some schools are trying to turn the clock back by reverting to past syllabuses. There are, in addition, other pressing claims on the school budget and the temptation is very great for senior management teams to postpone funding for technology.

Technology — going forward or not?

This can only mean one thing: technology may stand still, or it may actually go backwards in the short term — at a time when technology in the real world is advancing at a great pace. We need our technological understanding and manufacturing to be of a high order, and we need to set our sights not on the immediate future but on ten, fifteen or more years ahead.

Technology in schools has been a troubled area since its conception, and now that a clearer path is being laid by technologists, we must hope that it brings about a new age in school technology.

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Does 'Voltless' Electronics help?

Bridget Elton

PGCE student, Manchester Metropolitan University

In the last issue of *Design & Technology Teaching*, Paul Jones put forward the idea of 'voltless' electronics to help pupils to grasp concepts such as resistance*. Here Bridget Elton suggests an alternative view

Analogies are useful in understanding and teaching electronics, but a bad analogy can add to confusion. This article suggests an alternative to the 'voltless' model, and points to the need for greater co-ordination with science faculties.

Many teachers of technology (and soon-to-be-teachers, such as myself) will have recognised the dilemma in teaching electronics which Paul Jones describes in 'Voltless Electronics at Key Stage 3'(Vol. 27 no. 2). Technology is supposed to be about designing and making, not a lot of electronic theory, but without some understanding of what is going on in a circuit how can pupils get beyond what he refers to as the 'prescriptive projects that give little experience of the nature of designing with electronics'?

■ Problems with the Waterfall

Unfortunately, in attempting to make things clearer, Paul Jones adds to the confusion, and not only in electronics. Under 'Simplifying the problem' Jones uses the analogy of a waterfall, but his description of what happens in the waterfall itself is inaccurate. He says 'If the height of the waterfall is constant, then the speed of the water hitting the ground varies *only* with the blockage at the top' (his italics).

In fact the blockage at the top is irrelevant to the speed of the water hitting the ground. The speed of the water at the top of the waterfall can be divided into a horizontal and a vertical component. The slope of a river is so small that we can regard the speed of the water at the top of the fall as equal to the horizontal component alone. The vertical component is effectively zero under all circumstances, and the speed of the water as it hits the bottom is therefore dependent only on the height of the waterfall (I am ignoring the friction of the air).

What the blockage does do, of course, is reduce the *rate* of flow, i.e. the quantity of water which falls in a given period. This is analogous with increasing electrical resistance which, for any given voltage, reduces the current (the rate of flow of electrons, i.e. the quantity of charge which flows).

■ The 'closed circuit with pump' analogy

I think a better analogy than the waterfall is a pump connected to pipes with constrictions or blockages in them (see Figure 1). The pump is the battery, the constrictions are the resistance and the water flow is the current flow. If you add a water wheel (more resistance), it becomes clear that this system is doing work, just as the simple circuits the pupils are familiar with do: lighting bulbs, sounding buzzers, turning motors. If you want to describe this circuit without reference to voltage, you can, although it may sometimes be useful to replace the pump with a more powerful one and discuss the effect on current.

This analogy has two further advantages. Firstly, you can turn the pump off to simulate disconnecting the battery, which is more difficult with a waterfall. Secondly, and more importantly, this analogy shows a closed system, and thus reinforces the idea of a *circuit*. Research[1] has shown that many children fail to grasp that a circuit is essential for current to flow, or that the current flows in the same direction all the way round. The waterfall analogy tends to encourage the (surprisingly common) 'one wire' view (see Figure 2).

■ Current gets 'used up'

When Paul Jones uses his model to explain a simple series circuit the problem gets worse. Many children have the 'common sense' idea that current is 'used up' as it flows through components which obviously need energy to make them work, such as light bulbs.

This 'common sense' idea is confirmed for them by the fact that batteries run out. What actually gets used up of course, is *energy*. We need to help pupils distinguish between energy (or power — power equals energy per second), and current. If children think that current is used up, they will have tremendous difficulty designing even the simplest circuits.

Again, the 'closed circuit with pump model' helps to make things clearer. It will be obvious to children that the flow of water is the same in all parts of the circuit and current is not used up (otherwise there would be gaps in the water!). They also see clearly that the power output increases and decreases when current does. The change in current in the model can be attributed either to a reduction in blockages (resistance) or to an increase in pump output (voltage).

Jones's diagram of a series circuit (his Figure 3) on the other hand, with its large arrow going into the large resistance and small one coming

* As several sharp-eyed readers spotted (Paul Jones included) there was an error in Figures 5 and 6 in his article. The battery should have been shown connected between the buzzer and the emitter of the transistor, not between the variable resistor and the collector.

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Fig. 1

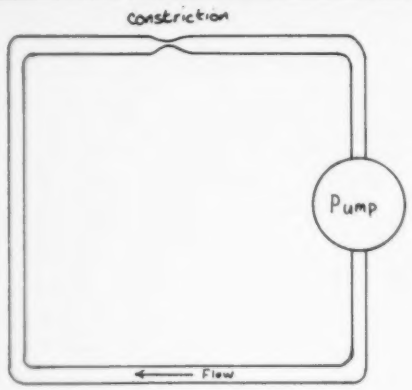


Fig. 2

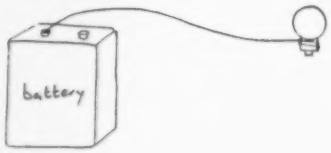
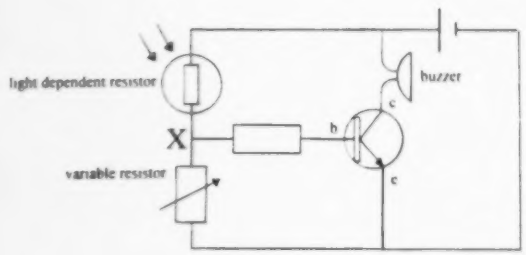


Fig.3



out, reinforces the notion that current is used up. Indeed, Jones advocates deliberately confusing the concepts of power and current. Since in science they will probably be taught to distinguish them, this can only result in confused pupils.

Errors in the transistor circuits

In the section on light and dark detecting circuits, there is an error in both diagrams. I suspect that this is merely a drawing mistake since, as drawn, the circuits (his Figures 5 and 6) will not do anything at all. The corrected circuit is shown in Figure 3. This is a rather unusual way of drawing it, but on the basis of the original diagrams I think this is what was intended. With the battery in the original position the collector and emitter are at the same potential, so, voltless model or not, no current will flow.

Is there a better way to teach electronics?

Paul Jones has attempted to deal with a problem created for technology teachers by the National Curriculum. Despite rationalisation in the new orders, application of electronics is taught in technology, while knowledge and understanding of electricity is taught in another faculty. I know that cross-curricular co-ordination is easier said than done, but could we not at least agree a common set of terms? Maybe there is a case for not teaching electronics until say Year 8, by which time it can be hoped that the children will have covered at least basic electric circuits in science.

Maybe we should concentrate on digital electronics which lends itself to the building blocks approach — I would be very interested to hear about any good digital projects. Or maybe the electricity part of science and the electronics part of technology could be taught by the same teacher — perhaps even in the same series of lessons? The National Curriculum says what has to be taught, not which faculty it has to be taught in.

My impression is that electronics is one of the least successful parts of the technology curriculum. As a PGCE student I don't claim to have the solutions, only that I would like to be part of finding some of them. I hope there will be more articles which address the problems which Paul Jones tackles, and particularly articles from teachers who have run successful and imaginative projects in electronics. I would also welcome correspondence on the issues I have raised, and I can be contacted at 11 Desford Avenue, Manchester, M21 OTG.

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See, for example:

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Multicultural and Inter-disciplinary Aspects of Design and Technology: an Overview of Japanese Carpentry

Graham Howells

Department of Education, University of Swansea

Japanese carpentry treats both tools and wood with a reverence that may seem a world away from the workbench in British schools, as Graham Howells reports

Visiting a trainee English teacher on teaching practice recently, I found her encouraging the pupils to write haiku, a Japanese form of poetry with a very simple structure. Having recently returned from a two-year contract in Japan, I was able to lend the student a book of haiku poetry with the Japanese and English versions printed side by side. The pupils were able to copy the characters and to have a brief introduction to a completely different mode of writing from that which they were used to. This episode represents a very small contribution to intercultural awareness, and we are accustomed to these contributions coming mainly through the arts and humanities areas of the curriculum. This article will try to show how teachers of design and technology might also be able to give a broader perspective to both the practical and the intellectual sides of the subject.

Religious background

We are used to the idea of a close connection between the medieval craftsman and the spiritual life of his time. The great cathedrals represent some of the most advanced technology of the period. We may imagine the consultations between the bishop, with access to the accumulated scientific knowledge of the ancient world preserved in texts, and the chief mason, relying on knowledge accumulated from a lifetime's experience. As far as we can tell, however, there was a separation between the lives of these men: one existed in a full-time religious life, the other in a secular one. In Japanese tradition the carpenter, although not a priest, has traditionally been much more closely associated with the spiritual values ascribed to materials, and to religious ceremony than his European counterpart.

If we are studying the relationships involved in Japanese carpentry therefore, we are immediately taken into the interdisciplinary area of comparative religion and there is an opportunity here to link with RE teaching. Coaldrake illustrates the strong connection between the Japanese carpenter and religious observance:

> The deep religious meaning of the Way of the Carpenter is reflected in the many solemn ceremonies and rituals that have been performed since ancient times as an integral part of the building process. Most of these ceremonies follow the rites of the native Shinto religion, but there are wide variations in observances depending on local or family customs.... The cyclical rebuilding of the Grand Shrines of Ise every twenty years is the supreme example of architecture transformed into ritual.
>
> Even in contemporary Japan, ground-breaking, ridge-raising and completion ceremonies are still observed in many building projects. The ground-breaking ceremony (*jichinsai*) begins the on-site construction process with rituals designed to appease the tutelary gods of the building site and to pray for the safety of all concerned in the building operation.
>
> In traditional practice, the chief master carpenter himself frequently officiated at the ceremonies, donning the robes of a Shinto priest and intoning invocations and blessings ancient in origin.
>
> Coaldrake, *The Way of the Carpenter*, 1990:5

On examining the belief system of the Shinto carpenter, we find a great intensity of feeling towards his materials which comes from the allocation of spiritual value to all living beings. The selection of wood for building involves an understanding of the personality of the mountain on which the trees have grown, and something of that personality is carried into the buildings that are constructed from those trees. Thus trees that grew on the south side of a mountain should form the south side of a building, those from the north should face the north. One of the last remaining temple master carpenters, Tsunekazu Nishioka, stated: 'To grasp the personality of a tree, you must converse with that tree. Whenever I fell a tree, before I raise the saw I pray, 'I pledge, as a temple carpenter, that I will do nothing that will extinguish the life of this tree'.'

Within the philosophy of Christianity, with its emphasis on the transcendental, the material presence of the cathedral or church is simply an expression of human striving to escape the earthly shackles of original sin; in Shinto the temple expresses the essence of the natural forces that shaped both the materials and the faith of the people. This difference is accentuated by the development of European architecture into stonework, whereas the Japanese temples remained wooden. The mason dominated the stone, carving it to his will, whereas the Japanese temple carpenter observed the twists and stresses built into his

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PUPILS AS MAKERS
The Crafts in Secondary Schools

NATIONAL CONFERENCE ON FRIDAY 3RD NOVEMBER 1995
10.00-4.30 at the Forum Hotel, Cromwell Road, Kensington, London SW7

Fee: £50 with 10% discount (£45) for school based delegates (to include lunch, tea and coffee and an advance copy of the National Survey report *Pupils as Makers — The Crafts in Secondary Schools*)

As part of current research into the role and importance of *learning through making**, the Crafts Council, in partnership with Roehampton Institute London, commissioned a survey of current provision for, attitudes to and practice of craft at Key Stages 3 and 4. Questionnaires were circulated, via the head teacher, to all Design and Technology and Art and Design Departments in secondary schools in England and Wales. The excellent response — over 2,400 departments completed and returned their questionnaires — indicates the strength of interest in the current debate and about the importance of practical learning in general education. *51% of the returned questionnaires were completed by Design and Technology departments.*

The conference will explore the implications of the findings of the survey and the action required at national and local level to secure resources for practical learning through intelligent making. Speakers will include Tony Ford, Director of the Crafts Council; Dr. Rachel Mason, Survey Director; HMI Peter Jones and HMI Michael Ive.

The conference is being run by the Crafts Council in partnership with the National Society for Education in Art and Design, as part of the NSEAD'S annual course and conference.

***For further details about* PUPILS AS MAKERS: The Crafts in Secondary Schools and conference booking forms please contact:**
ANNE INGALL, NSEAD, THE GATEHOUSE, CORSHAM COURT, CORSHAM, WILTSHIRE.
Tel: 01-249-714825
Fax: 01-249-716138.

***LEARNING THROUGH MAKING**: the Crafts Council's research project, please contact: Susan O'Reilly, Education Officer (Schools and Young People), Crafts Council, 44a Pentonville Road, London N1 9BY. Tel: 0171-278-7700.

trees during growth periods of up to 1,000 years, and selected his wood so that the strengths and weaknesses of related timbers cancelled each other out. This 'organic' method of construction, together with the innate flexibility of wood and the subtlety of jointing systems is, of course, imposed by the geological factors that impose earthquakes on Japan with tragic frequency. The stone-built European cathedral simply would not survive in Japan without massive strengthening that would destroy the aesthetic effect of stone tracery that we are familiar with. When the 1923 earthquake hit Tokyo, causing immense devastation, the five-storey wooden pagoda of the Kaneiji temple, 32 metres high, survived intact. Post-war research into earthquake-resistant structures showed the value of transferring into modern materials the elasticity inherent in the nature and design of the wooden buildings.

In the temple complex of Horyuji in the ancient city of Nara, the carpenters have summarised their relationship between themselves, their work and their material:

> To form a pagoda is to form wood
> To form wood is to form a tree
> To form the tree is to form a man
> To form a man is to form the mind
> To form the mind is to understand the craftsman
> The master craftsman who errs is unworthy of his trade

If we needed any confirmation of the value of this philosophy, we can find it in the fact that in Horyuji are some of the oldest wooden buildings in the world, up to 1,200 years old. It is worth noting in passing that in the modern industrialised world of Japan, a diluted form of the carpenter's philosophy is still found. The craftsman who errs on the Toyota production line, the shopgirl who does not wrap goods properly, the computer assembler who misplaces a dab of solder, are all made to feel that they have done more than just a sloppy job — they have let down themselves as well as the team they work with.

■ Materials and Ecological Consequences

We have seen how the traditional Japanese carpenter identifies with his material. In the European tradition we find also the use of particular woods for specific purposes, and the use of either natural or artificially formed curved trunks and branches in the construction, for example, of knees in roof-beams and wooden shipbuilding. The Japanese carpenter took this further, with a family growing its own trees from which an individual would cut the wood from which he fashioned his tools. In this way the craftsman felt that the tool was an intermediary between him and the larger, older and therefore more venerable trunk that was to be shaped and given a new life as a structural member of a temple. As Prof. Teijiro Muramatsu of Hosei University puts it.

> The Japanese love the beautiful grain of unpainted wood, a love which led to the development of delicate carpentry tools and the skills to handle them. For instance, there are many kinds of planes, from rough to fine, and each of them [is] individually suited to a particular hardness of wood.

The wood used for the most important load-bearing sections of the temple was (and is, in restorations) hinoki, Japanese Cypress or *Chamaecyparis obtusa*. It is an evergreen conifer native to Japan that grows to a height of 40 to 50 metres, with a straight grain that makes it easy to split. As has been noted above, hinoki trees may be cut when they have already been growing for 1,000 years, and some of the components in the Nara buildings have been standing for the same length of time. Hinoki has some interesting qualities:

> One of the most remarkable features of hinoki is its longevity. Scientific tests have found that it is 30 percent stronger two hundred years after it is first cut. Thereafter it gradually weakens until a thousand years later, when it has returned to its original strength. The secret of its strength lies in its fine grain (only about one millimetre between growth rings) which aids oil retention.
>
> Coaldrake, 1990:20

This quality adds another dimension to the Japanese carpenter's relationship with his craft — time. The tree he cuts has been living for an almost unimaginable time before he was born,

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and will survive for at least as long after he is dead, so the individual human intervention serves simply to change the purpose of the wood within the living world. The European builder who puts beams in a cathedral roof is creating stability and beauty for the greater glory of God, but the material is a subordinate part of that relationship.

There is, however, a price to pay in ecological terms for the Japanese devotion to wood. Hinoki is now rare in Japan, so it is imported from Taiwan. We read that Japanese timber merchants are responsible for 'logging out' South-east Asia and, along with Britain and Germany, are the biggest importers of South American hardwoods. While visiting a Japanese pottery village I heard a potter complain that it was difficult to get the red pine he needed for his traditional wood-fired kiln. When I pointed out that we were surrounded by pine-covered hills, I was told that the Japanese preferred to import their red pine from Malaysia, thus preserving the aesthetic qualities of their own hills. Clearly the Japanese have to do some serious thinking about their relationship with a valuable tradition, and the limited resources of the modern world. There seems to be a sublime ignorance in Japan of the outside world's concerns about the country's predatory attitudes: the Japanese pavilion at the Seville Expo was a proudly all-wood construction.

■ Tools

We have seen how the wooden shafts of the tools could come from private plantations grown by a family of carpenters. The metal sections of cutting implements would be made by specialist smiths using, in the case of knives and chisels, the techniques used in the fabrication of samurai swords. The metal is heated, folded over on itself and beaten, then folded again and so on. In the Carpentry Tools Museum in Kobe one could see video films of this technique, and of the resultant tools being used. (At the time of writing, I do not know if this excellent historical museum has survived the recent earthquake that devastated much of Kobe.)

There is an interesting difference between the Japanese wood chisel and its western counterpart: paradoxically, it has to be able to take and hold a sharper edge than the western chisel precisely because most of the woods used are softwoods. The head of the chisel is of a brittle, hard steel which is forged onto a softer steel for reasons of resistance and economy. The underside of the chisel is concave to allow an easier separation of the chisel in deep cuts and, as with the western tool, it has a hardwood handle. Sharpening these tools is part of the morning ritual of the carpenter; he will use two or three stones of varying smoothness and my pottery teacher, who had been a carpenter, told me that he spent an hour each morning sharpening, to 'concentrate my mind on the day' s work' . It is indicative of the relationship of the Japanese craftsman with his materials that one heard of specially smooth volcanic stones for sharpening kitchen knives being sold for up to £1,000.

An interesting tool with no equivalent in the west is the *yariganna*, or spear plane, which I saw being used on video in the Takenaka museum. The tool is literally a spear, which is held in two hands and passed along a beam. Perhaps the nearest equivalent is our two-handled drawing knife. Both are unsupported by a guiding frame and rely on the strength, control and eye of the user for good results. Although it had gone out of use by the end of the nineteenth century, Tsunekazu Nishioka recreated one of these tools in the restoration of the main pavilion of the Horyuji and made the following comment:

> Hinoki wood cut with a *yariganna* is immaculately smooth to the touch and rain drops bounce off cleanly upon contact. I feel this to be one of the reasons that ancient wooden structures survive longer than those erected in modern times. The electric planes available today make work go faster, but the surfaces they produce are rough and uneven, and since rain-water is not cleanly repelled the decaying process is accelerated.

It would seem that Mr Nishioka's recreation has caught on, because I noticed two *yariganna* in a display case in a hardware shop in the town of Miki, a tool-making centre near to Kobe.

Another interesting aspect of Japanese cutting tools is that the saw and the plane are both used with a pulling motion. The saws seem to be very flimsy but an American friend recommended them as 'the sharpest saws you will every own'. An interesting variation is the double-edged saw with cross-cutting teeth on one edge and ripping teeth on the other. The

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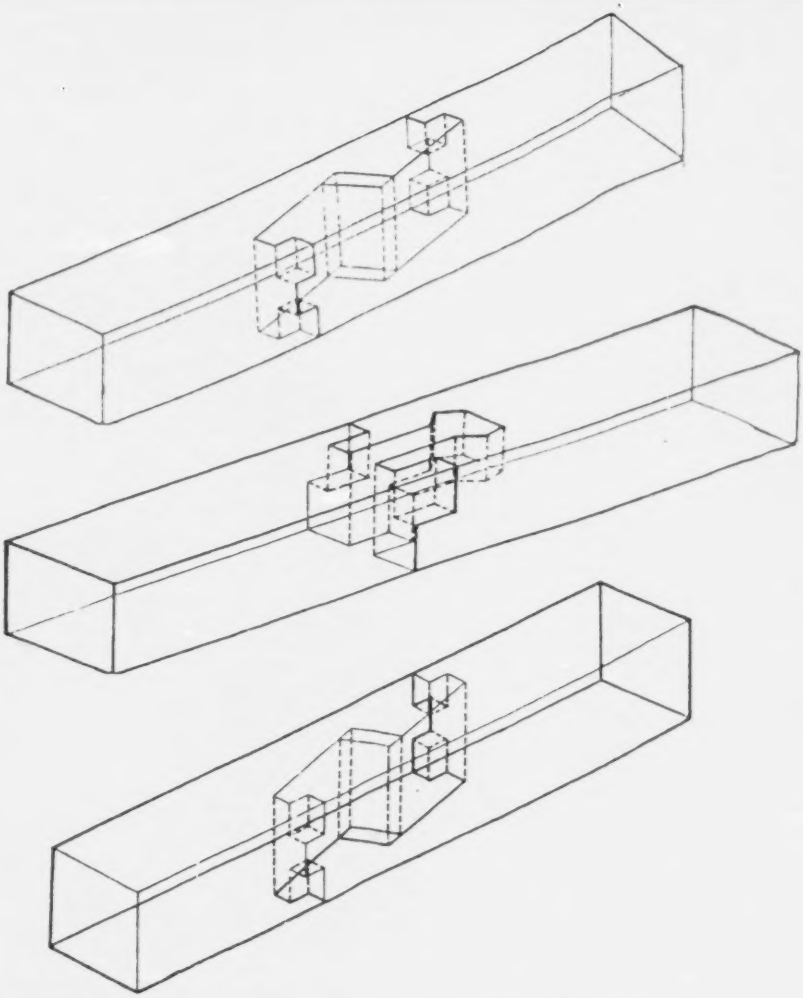
Fig. 1: The janawa-tsugi joint

Fig. 2: The kama-tsugi joint

Fig. 3: The sao-tsugi joint



traditional plane is similar to the western type, with a metal pin passing through the wooden body and the blade being held by a capping piece tapped into place with a hammer. As with the chisels, the plane blade has a hard steel cutting edge forged onto a mild steel body. The Takenaka museum videos show carpenters planing long streamers of shavings from beams, and Coaldrake's reference to this echoes Nishioka's view on the water-shedding quality of well-smoothed wood:

> The blade is carbon steel tipped and normally used in conjunction with a capping iron ('chip breaker'). This increases the overall efficiency of the planing blade by directing wood shavings away from the cutting edge of the blade. The combination of superlative cutting steel, skilful technique and careful setting of the blade results in long, continuous ribbons of shavings, which may be less than 0.03 millimetres in thickness, and a polished wood surface on which water pools as if on stone. Sandpaper should not be necessary to perfect the surface. In fact sandpaper is still regarded as anathema by strict Japanese carpenters who believe using it violates the fibre of the wood.
>
> Coaldrake, 1990:66

The carpenter will also incorporate a series of two or three concave areas on the base of the plane to reduce resistance as the plane passes over the wood.

Another interesting aspect of traditional Japanese carpentry is the use of the *sumitsubo*, the equivalent of the western chalk line. The *sumitsubo* is usually a beautifully crafted

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hardwood reservoir of ink incorporating a wheel over which passes a cord. As the cord is pulled out, it is soaked in ink and then laid along the wood to be marked.

Joints and Techniques

The aspect of Japanese carpentry that is most obviously relevant to design and technology teaching in Britain is the application of types of joints that are not common in European carpentry, if used at all. According to the translator's note in Seike (1977:10) 'Only three of the joints in this book (the cross lap, common dovetail, and bevelled shoulder mortise and tenon) have legitimate equivalents in English'. Having studied the joints illustrated in Dr Seike's book, I would argue with that statement, but the 48 joints illustrated in this work contain some that are not used in Britain, and it is claimed that Japanese joinery has a vocabulary of up to 400 different joining methods. This does not mean that there is no overlap between the two traditions, but the simple Japanese scarf joint illustrated in Seike, for example, has a much more acute angle than the European one, with its customary proportion of 6:1.

Illustrated opposite is the *janawa-tsugi*, translated as the mortised rabbeted oblique scarf joint, which is designed to withstand stresses of tension and bending. When a bolt and strap are added, it is claimed that the joint is almost as strong as a sound beam of the same dimensions (Seike, 1977:108).

The *kama-tsugi*, or gooseneck mortise and tenon, takes its name from the Japanese word for the reared head of a snake, and was invented to resist tension forces. Over time the head of the male joint developed from a square shape to that shown here.

Sometimes building conditions do not allow space for the gooseneck mortise and tenon joint to be inserted from above or below, and in these circumstances the following joint, the *sao-tsugi*, or lapped rod mortise and tenon, is used.

Conclusion

What application does this very brief introduction to Japanese carpentry techniques have to our learners? As I suggested at the beginning of this article, there are multiple opportunities for linking with other areas of the curriculum that deal with questions of religion (the shinto and Buddhist temples), biology (the different types of woods, the ecological consequences of the Japanese attitude towards wood), geography (the physical nature of the Japanese archipelago and its exposure to earthquakes) and, of course, design and technology. I have not been able to illustrate more than three of the joints used in Japan, but these technically challenging and anyone interested in obtaining the Seike book, will find another 45 joints to experiment with. This need not be merely an academic exercise: anything that expands the learner's vocabulary of techniques is useful. I understand that in the USA woodworkers are importing Japanese tools and some readers may be interested in doing the same. The planes and chisels, although expensive, are works of art in themselves. I cannot give the names of any British importers of these tools and it may be easier to try to find someone returning from Japan to bring them. The town of Miki, at the back of the hills behind Kobe, is a centre where tools are made and by making a trip to one of the two branches of a large hardware supplier there, one can find every type of implement for carpentry, masonry, horticulture and the kitchen.

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Technology in New York State Education System

David Hendley

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David Hendley looks at the way technology teaching is organised in New York State

There is widespread recognition in the industrial world of the importance of education in technology. The introduction of Technology as a compulsory subject in the National Curriculum in England and Wales was driven by a very clear vision of *why* Technology should be part of the curriculum of all pupils. The Orders for Technology made it clear that technology should not be seen as a 'retread' of craft subjects, but as a 'broad-based introduction to the way the adult world tackles designing and making' (Clarke, 1991). Technology was seen not merely in vocational terms, but as an essential component of the education of all regardless of future careers. It was felt that everyone needed a broad-based understanding of the processes involved in product design and making to increase their ability to be critical and discerning about choice of products and systems. The result was a curriculum which focused upon the processes of planning, designing, making and evaluating in design and technology, rather than prescribing specific content. At the heart of this holistic approach to Technology is pupil acquisition of technological capability in which pupils can be expected to produce solutions to problems which can be tested in use. It is, therefore, far more than practical capability that the National Curriculum is expected to achieve. Design and Technology was seen as the place where the abstract and the practical met and there were high hopes in its ability to end the rigid separation of the academic from the vocational.

The government was also concerned to change the attitudes of both pupils and teachers as well as the general public towards technology and in particular improve the status ascribed to vocational qualifications. Such qualifications should be seen as having equal status with advanced level academic examinations, and increasingly be seen as a legitimate and important route into higher education and better jobs.

It is in this context that I, a teacher educator with responsibility for the training of teachers in Design and Technology, became interested in finding out how the United States approached technology in its schools. I decided to make a study visit to what is, after all, the largest industrial nation in the world to find out their attitudes towards Technology and how they translated into curriculum planning and practice within schools.

In the summer term of 1994 I arrived in New York State (NYS) and spent three weeks visiting schools, observing technology lessons and talking to administrators, teachers and pupils about technology. In this paper I report on this visit and make some observations about the very different attitudes which are held towards technology and how this influences the ways in which NYS approaches education in technology.

The System

The pattern of education throughout the United States is very similar to that of the UK. It is basically divided into two phases:

Elementary school

Secondary school (comprising middle school and high school)

Elementary school is sometimes subdivided into primary and middle school. Primary can be Grades 1 through 6, and middle is Grades 7 to 8 (possibly subject to change). Grade 1 is for 6/7-year-olds. As a consequence students start high school at age 13+ years. Kindergarten is available for children from age five and runs for one year.

High school runs from Grade 9 to 12. In New York State the school day is generally from about 8.15 am to 3.30 pm with one half-hour break for lunch and no morning or afternoon break. Teachers have preparation time almost every day and can take coffee during these periods. They are much more relaxed about leaving their classes for short periods. The curriculum is decided state by state and there is no National curriculum. This is protected in the Constitution. Thus New York State determines the core curriculum for its schools. Within the elementary phase, the compulsory parts of education are:

Music
Art
PE

Also, the State recommends the following should also be taught:

Library
Computer.

These five areas have specialist teachers. The remainder of the curriculum, described below, is taught by the Grade teacher. The Grade teacher usually stays put and the students move to another teacher each year. Occasionally the

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teacher will stay with the class as they progress through the grades. The above are considered to be an important part of this phase of education. Students are also taught maths, language and social sciences; very little technology is taught. The students' progress is checked (together with a check on the teaching) through grade tests and Pupil Evaluation Performance Tests (PEPs). These latter occur at the end of Grades 3 and 6. The grade tests occur as follows:

Grades 3 and 6
Maths and Reading

Grade 4
Science (a practical test)

Grade 5
Writing

Grade 6
Social Science (short answer, multiple choice and essay).

In the high school phase, the first two years appear to be fairly general, and much the same subjects are followed, with the addition of a compulsory technology course, which must take up 40 weeks of the two years, usually in 20-week blocks. After this period, students have to complete the following compulsory subjects:

Maths	3 years
English	4 years
Science	3 years
History	4 years

Modern Foreign Language 1 year

Introduction to Occupations, which includes the structure of occupations, finances, etc.

The students then opt for courses which lead them into the career choices or college routes. Some of the courses are technology based. These will be described later.

Technology in New York State Schools

The New York State definition of technology is 'the systematic approach to solving problems through human and man-made and natural resources' (State Education Department, 1987).

It is interesting to compare this definition with the statement accompanying the new Orders for Design and Technology in the UK: 'Pupils should be taught to develop their designing and making skills with knowledge and understanding in order to design and make products' (SCAA, 1994).

There is no National Curriculum for technology in the USA. There are some states where an industrial arts type curriculum is provided. In these states students work on set projects. In New York State there is a great emphasis on problem solving and the use of a range of resistant materials including ceramics.

In NYS, there is no formal technology taught in the elementary schools. In the high school, technology is a taught element, which has a fairly loose structure of areas to be covered. The Education Department has produced teaching materials for Grades 7 and 8 which cover a wide range of areas in order to
' ... enable seventh and eighth grade students to understand the concepts that underlie technological systems....the majority of children in these grades will benefit educationally from concrete experiences which will involve a variety of senses' (New York State Education Department, 1987).

The State has produced a ten-module course. These modules are:

Getting to know technology
What resources are needed for technology
How people use technology to solve problems
Systems and subsystems in technology
How technology affects people and the environment
Choosing appropriate resources for technological systems
How resources are processed by technological systems
Controlling technological systems
Technology and society: now and in the future
Using systems to solve problems.

Time spent can be as little as one week per module and there is no upper limit. All the State requires is that these areas are covered during the 40 weeks. At the same time students will engage in 'Home and career skills'. There appear to be no mandatory areas to be covered within these.

All the modules are practically based. The State Education Department believes that '...the use of modern tools and machines is an excellent method of providing children with

the successful, creative experiences that help build the skills and confidence needed to live in an ever-changing environment.' (ibid.). The course is hierarchical in nature and builds on knowledge and skills learnt throughout the course. The basic premise is that technology is an all-pervasive part of life; so, through a study of the resources which are common to all technologies, students are provided with conceptual tools which can be used in problem solving in three aspects of technology:

biologically related technology
information/communication technology
physical technology.

Students further their understanding of technology as they study the ways that humans have combined the resources of technology to create technological systems. Finally, students address additional generic technological concepts such as control, career opportunities and societal implications of technology.

The course is based on the premise of providing links between theoretical concepts and practical applications and that technology is itself an interdisciplinary subject. The course itself also has several 'constants' which reappear throughout. These are:

systems of technology
mathematical concepts
science concepts
societal implications
communication skills
safety and health
psychomotor skills
career-related information
creative problem solving
transfer of learning.

The students are also required to complete a course in home and career skills. Here they learn about home economics etc.

In Grades 9 to 12, students can study some areas of technology or not. Textiles and Home economics are a part of the curriculum in New York State, but there is no link to technology. It is a separate subject area. The emphases of technology are solely around resistant materials and computers. Similarly, business courses are considered to be separate from technology. They do not see a direct connection, other than the identifying a need, costing and research.

There are a number of Technology options including:

construction materials
engineering science
CAD
production
transport.

Teachers did not consider themselves to be well resourced. Each school had a room of computers devoted entirely to CAD, with one machine per student (one wonders what they would need to regard themselves as well equipped!). The workshop areas all have at least ten computers. There is a division of opinion, as in the UK, as to whether to use IBM compatibles or Macintosh. The division appears to be evenly split. Most teachers use Autocad as standard. The New York State technology programme is not a compulsory one. The only requirement is for schools to provide a 40-week course in Grades 7 and 8. If schools adopt the New York scheme, they will have all their lessons set out for them, together with strategies for delivering every lesson.

School Visits

I visited a semi-rural part of New York State with characteristics similar to those within the area in which I work in South West Wales. Over a three-week period I spent time in two elementary schools, two high schools (one rural and one urban of each) and one vocational school which serviced all the high schools in the area. I spoke to administrators (in the NYS administrators have much control over the content of the curriculum), principals, teachers and pupils and visited a number of classrooms to see technology in action.

Although not compulsory, all the school principals I met were in agreement that technology is an essential part of their schools' programmes and make time and money available in order that the subject receives priority. However, none of the schools I visited had adopted the New York State scheme as described above. There seems to be great resistance towards accepting a curriculum determined at government level, and whilst they were all familiar with the scheme and felt it had a lot to offer, had decided it was not for them. Instead the schools had designed their own courses, one of which I describe below.

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School Technology — some examples

The schools offered a course called 'Design and Drawing for Production' in which students learn the various methods of sketching and drawing manually at first in order to teach the various concepts. They are introduced to CAD at a later stage, when they have had plenty of practice in the manual skills and have gained an understanding of the concepts. This removes the necessity of teaching more than one concept at a time. Students do not undertake much model building, but there is a quite a lot of drawing and sketching taught including perspective, isometric and orthographic. Rendering and other methods of adding colour for enhancement are also taught.

In Grade 9, ages 14 and 15, they have an architectural drawing class in which the students design their own ideal house. They produce a floor plan, elevation views, wall sections, lighting and heating schematics. They write up a report on the choices they have made. They also build a scale model of their plan, using card, foam card, wood, etc.

Workshop Facilities and Students

The facilities schools have to support technology is impressive, and far exceeds any provision I have seen in the UK. Workshop machinery is quite extensive although the age of the individual pieces is variable. Students are allowed far greater access to these machines than they are in the UK. For instance, radial arm saws are extensively used by students. They receive individual training on the machines and are not allowed to use them on their own until the teacher is satisfied they are safe to be left. The number of students per class is less than in the UK. On average, in Grades 7 and 8, possibly 15 students, in Grades 9 to 12 around 10–12 students per class. The workshops are also much larger than those in the UK. The amount of tools is sufficient for each student to have a complete set, so there is no need to share. Materials do not appear to be a problem, although all teachers I spoke with say that they do not have enough. Some of the projects the students are involved with are much larger than those attempted in the UK. For instance, most students will build a barn. This is done in sections in the workshop and then transported out to a suitable site for erection. Perhaps, it is worth observing here that most houses in the US are wood-framed and so work of this sort is valuable; also very many Americans do expect to build their own house.

Information Technology

The resources for IT are extensive, although the teachers I spoke to use Autocad as the CAD system. Those who run it on PCs say that Macintosh is not quick enough. However, those who do run it on Macintosh do not complain. Most of the schools I visited are expecting deliveries of more computers to update their present stock. They seem to think that their current computers will remain with them.

The elementary schools also have excellent computer facilities to support the compulsory subject of computers on the curriculum. In these schools 'Technology' meant computers. The children in these schools had computer lessons every day and additional work in subject studies to promote IT across the curriculum. As far as I could tell the elementary schools had opted for the Macintosh because of its user-friendly capability.

BOCES — Board of Co-operative Educational Studies

I also visited a BOCES school. These schools were set up about 20 years ago to act as vocational schools. Initially, they were state funded, but now finance themselves by high schools paying for their students to attend. The way they work is as follows: students in Grades 11 and 12 can spend half of each day at the BOCES, instead of at their high school. The remainder of each day is spent at their 'home school'. What seems to happen is that students who are not academic high flyers or who have discipline problems in the high school are those who attend BOCES.

It is noticeable that the students are all motivated and work well without too much overt supervision. One class I observed stayed on task for one and a half hours and then cleared up at the end of the session without being told. The workshop was swept clean, the tools and equipment were checked back into the cupboards by the students. The teacher did not have to say anything to them. The ethos of all schools I visited was one of working. They do have discipline problems, but the scale is

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much reduced. However, we should remember than this is a semi-rural area and it is well known that some areas have real problems!

The courses offered are all vocational: cosmetology and hairdressing, commercial food trades, trade electricity, computer information technology, welding, carpentry, mechanical technology, conservation, auto body repair, auto mechanics, health assisting, building trades (discontinued at present), criminal justice, heating, ventilating and air conditioning/refrigeration, machine trades, mechanical science, plant/ animal science, secretarial information technology, small animal science. However, this facility in the US is a vast scheme with many teachers, many of whom have come from industry and commerce to work with young people. They are all trained teachers.

All courses award a certificate on successful completion of the course. These awards are recognised by employers. All courses include an element of work experience. This is proving very successful now after a hesitant start. Many students are being offered jobs with their work experience firms on completion of their course. Some courses are beginning to get some nationally recognised awards for their students on completion of their course — commercial food trades for example. An interesting feature which is offered is a young mother school. This offers young mothers nursery facilities for their children while they attend school to graduate. In the normal high school this is not possible.

Of the courses offered, the most interesting to me were the electrical trades and mechanical technology courses. Both courses are of two years' duration and have a requirement that students pass the first year before they progress to the second. The electrical trades course covers areas such as house wiring, industrial wiring, alarm installation, telephone installation, computer-based costing, computer programming in BASIC and computer control. The course leads straight into degree programmes in electrical and industrial electronics.

The mechanical technology course covers areas such as technical drawing through to manufacture of designs, using injection moulding, vacuum forming, etc. The students design and make the moulds for their projects and then use them to make their products. The course also offers CAM facilities. The system used is not the most modern, but one that provides a good progression for students from their CAD work. Basically, the students produce a simplified program of the shape of the workpiece, which the machine would translate into G and M codes. The students save their work on tape, and this is then checked by the teacher, before the tape is taken to the CNC milling machine and the programme executed. The teacher is reluctant to introduce linked CAD/CAM at present. He does not see the need for this as it may confuse the students. They have a better feel for what is happening with his methods. The course leads directly into apprenticeships and degree courses in mechanical design as well as providing recognised qualifications for jobs.

■ Conclusion

The New York State scheme for technology does provide a different structure and purpose for technology in its schools compared with that of England and Wales. The New York State system also puts a much greater emphasis on the importance of technology in that its status as a subject is much greater than in the UK. However, it is only compulsory in Grades 7 and 8. Students appear to put together their own timetable based on their interests, which will include free time, and select their own major areas of study. They can also pick up other courses which can complement these major ones. There appears to be a gender division after Grade 8 in that not many girls take technology. In the schools I visited I found approximately five girls taking courses in some form of technology, usually the CAD-based ones.

The students are educated to be self-reliant, and so the work which is set them is generally completed without too much insistence from the teacher.

The BOCES in particular seem to produce highly motivated students who use their time in these institutes very well. The work experience elements of the courses here are somewhat different in that students are encouraged by the companies who take them on to return for a full-time job when they leave school.

It would seem that the differences between New York State and England and Wales are many and can be summed up as follows:

- There is a very different perception of the type of technology which should be taught

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in schools, England and Wales emphasising the process of designing and making products, NYS emphasising problem-solving skills, how technology affects society and vocational training

- In England and Wales technology is seen as something for all children, an important component of a balanced, broad education intrinsically relevant to all regardless of academic ability or vocational leanings. It has a much narrower target audience in mind in NYS with an emphasis on vocational skills and training
- As a result of the non-compulsory nature of technology except in Grades 7 and 8, very few girls opt for technology, whilst here all girls from 5–16 (14 in Wales) have to study technology as part of the National Curriculum requirement
- The decision of the UK to focus on the processes has meant that the updating of vocational courses has lagged behind. There is a tendency for the same craft skills to be taught through a design and technology framework, whilst in NYS the latest advances in computer control, electronics and mechanical technology have been introduced.

As we move towards the end of the millennium it is natural to speculate on what kind of education will be most relevant for our children, most of whose lives will be spent in the 21st century. Most people seem to agree that technology is an important part of education for the future. However agreement over the form it should take or the opportunities it should provide and the purposes it is intended to meet is, as we have seen in this brief comparison with NYS, far from settled.

I would like to thank all the teachers and students in New York State who made me so welcome and treated my questions with patience and understanding.

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DATA's Guidance Materials for Design & Technology

Key Stage 3

In March this year, DATA published two packs of guidance materials to support the new Order for Design & Technology. Some 22 conferences were held across the country, to introduce teachers to the new Order and to DATA's support material.

Two Units of Work from the KS3 pack are reproduced here, so that readers can get a flavour of what is available. They were created by a writing team of Ali Farrell, Eileen Small, Mark Hudson and Barry Payne and have been widely praised for their breadth of coverage and their practical approach. The pack contains the following:

20 page booklet
32 Units of Work
A Units of Work Framework
A Pupils' Planning Sheet
An A3 Planning checklist
An A4 Level Descriptions card

Packs are still available at £7.50 each (£13.50 to non-members). Contact DATA to place your order.

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Management & organisation of learning

Programme of Study focus

3 Designing skills
- b use design briefs
- e make proposals modifications
- j model ideas
- k develop plans and alternatives
- l evaluation skills

4 Making skills
- e use kits
- f use a variety of components
- i develop strategies for making
- j evaluate and test products
- k make improvements and modifications

Knowledge and Understanding

6 Control
- a design, use and interconnect systems
- c use switches
- e use inputs, control, outputs
- g analyse performance

9 Quality – identify and use criteria re:
- a meeting needs
- b fitness for purpose

10 Health and Safety
- a recognise hazards
- b gather information to assess risk
- c take action to control risk

Investigative, disassembly & evaluative activities (IDEAs)

- Hold a group discussion to evaluate existing greeting cards and to set up criteria to decide what makes a successful greeting card and how it can be made appropriate to the specific occasion
- Disassemble greeting cards to identify switching methods and control devices
- Investigate switch types/operation methods which will be appropriate to the product

Focused practical tasks (FPTs)

- Manufacture and testing of a circuit
- Manufacture of a switch for specific situation
- Design and production of graphics for the greetings card
- Installing a circuit and switch in the greeting card (package and operation to suit the situation/ occasion)

Design and make assignments (DMAs)

- Design and make an electronic greeting card (suited to an occasion selected by the pupil) that uses a switch to operate either light or sound output
- This will involve pupils in the selection and production of appropriate circuit/components and the design and manufacture of a switch to operate to given requirements (e.g. when the card is opened/closed, a section or button pressed, or a part moved). The card should be produced to a high standard using graphic techniques or DTP.

Opportunities for IT

CAD/CAM – design, layout and manufacture of PCB
CAD – use a cutter plotter for the net of the greetings card
DTP – use of text and clip-art or paint software package to produce original artwork
Database – for identification of components and applications

Assessment

When pupils are designing and making to what extent are they:
- generating ideas which draw upon external sources and the understanding of the characteristics of familiar products?
- clarifying their ideas through discussion, modelling and drawing?
- evaluating their own ideas, showing an understanding of the situation?
- working from plans they have produced, and modifying them in the light of difficulties?
- using a range of tools, materials and processes with increased precision and control?
- measuring and checking procedures, and suggesting alternatives?
- evaluating their own work by comparing it with their design intentions, and suggesting improvements?

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Flashy Greetings

Time allocation 16hrs
Key Stage 3
Year 8/9

The Context

This activity focuses on designing and making greeting cards for a celebratory occasion.

The Activity

This focuses on designing and manufacturing a greeting card that uses a purpose-built switch to activate lights (LEDs) or sound when the card is opened or a simple movement is performed.

Starting Points/Stimulus

- Disassembly of a commercial greeting card and novelty devices which have a greeting function – include examples from other times and cultures
- Investigate switch types and their operation
- Construct, evaluate and modify a circuit to flash LEDs on and off.

Key Experiences

Pupils will have developed knowledge and understanding about:

- control – switch types and forms
- how switches work and how they are employed in circuits
- electronics – circuit concepts, continuity, components and applications, circuit design and layout
- graphics – layout, text, fonts and sizing, nets (developments), colour use and application

and developed skills/strategies in:

- designing – researching for a specific need
- materials appropriate for the construction of their ideas
- circuit production (PCB, soldering)
- graphics.

Extension Activities

- Extend switch restrictions to include other operational criteria
- Extend circuit requirements to include delay after closing/opening
- Extend material to switch manufacture or packaging the circuit
- Include production of original artwork by use of paint or CAD package.

Curricular Links

Science – control concepts
Art & Design – development of graphics techniques, perhaps through use of IT

Key Vocabulary

Switches
Circuit production
Integrated circuits
Graphics terminology – colour, shape, line, form, nets

Resources

PCB production (or Veroboard or similar)
Electronic components (LEDs, 555 timer or flashing LEDs, buzzers or piezo resistors, capacitors, presets)
Soldering equipment
Prototyping materials for switches (e.g. use of nuts, bolts, pop rivets, springs, sheet metal, copper tape, washers, PCB, paper fasteners, soldering, etc.)
Card
Graphics equipment
DTP/WP software

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Management & organisation of learning

Programme of Study focus

3 Designing skills

d consider needs/values
f aesthetics, function, safety, reliability, cost
g properties of materials
l evaluation skills

4 Making skills

b select tools/processes/materials
d join/combine materials/components
f variety of components
g finishing techniques
j evaluate/test

Knowledge and Understanding

5 Materials and Components

a properties
c combine/process/finish
d heat treatment

8 Products and Applications re:

a intended purpose
b choice of materials/components
c production processes
d scientific principles

9 Quality – identify and use criteria re:

a meeting needs
b fitness for purpose

10 Health and Safety

b use information to assess risk

Investigative, disassembly & evaluative activities (IDEAs)

- Evaluate the safety accessories available and consider how well they do their job as well as aesthetic considerations.
- Discuss in groups what an article would be like in order for pupils to wear it, draw up an agreed list of criteria against which to evaluate their product later.
- Look at construction techniques and methods of fastening.

Focused practical tasks (FPTs)

- Discuss ways of evaluating design as well as the product.
- Demonstrate and practise threading a sewing machine, sewing straight lines and curves.
- Demonstrate and practise using fabric paints and pens, possibly producing a sample board.
- Teach pupils how to make simple patterns based on their design ideas, stressing the importance of accurate measuring.

Design and make assignments (DMAs)

- Design and make a fashionable safety accessory using textiles that would be worn by a young cyclist during winter months. Pupils will need to reconcile the potential conflict between the function of the safety accessory with fashion appeal so that a young person would enjoy wearing it.

Opportunities for IT

Database – research accident figures
CAD – designs to embellish their accessory

Assessment

When pupils are designing and making to what extent are they:

- using the information gained from their investigations to guide their design decisions?
- taking into account the views of users?
- setting their own criteria for evaluation?
- evaluating their work as it develops?
- using the sewing machine competently?
- considering the possible conflict between aesthetic appeal and function when making decisions?

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Be Seen to be Safe!

Time allocation 8hrs
Key Stage 3
Year 7

The Context

The context focuses on the need to wear safety clothing whilst cycling, particularly during the winter, and the need for fashionable accessories that young people would be prepared to wear.

The Activity

The activity focuses on developing pupils' evaluative skills, particularly around existing products and from which new ideas might be generated.

Starting Points/Stimulus

In small groups:

- Discuss current figures relating to the number of cyclists injured according to age, and the design needs and opportunities that pupils can see
- Consider safety accessories currently available, such as tabards, leg/arm/headbands, shoulder straps and reflective panels. Evaluate according to fitness for purpose, including aesthetic appeal.

Key Experiences

Pupils will have developed knowledge and understanding about:

- developing criteria for their design against which evaluations can be made
- the importance of considering the function as well as the aesthetic appeal of their designs
- components and processes that are used to produce commerical safety accessories
- some of the special finishes applied to fabrics
- use of a sewing machine

and developed skills/strategies in:

- evaluating their ideas and product as it develops
- selecting appropriate materials and equipment
- joining fabrics together
- using fabric paint and crayons
- using a sewing machine.

Extension Activities

- Discuss when safety clothing needs to be worn in school, what is appropriate and why
- Investigate other safety finishes applied to fabrics
- Design a poster to emphasise the importance of wearing safety clothing
- Research other forms of protective clothing and their applications

Curricular Links

Mathematics – measurement
Science – properties of materials, reflective fabrics, luminous paints
Art & Design – aesthetic awareness

Key Vocabulary

Aesthetics
Reflective material
Fabric finishes

Resources

Recent figures relating to accidents involving cyclists
Luminous fabric paints
Reflective fabrics
Selection of fastenings – Velcro, buckles, studs
General sewing equipment
Paper, pencils etc.

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The Roamer Games! An event for SET95 Week

Steve Woolley

Head of Technology, Bancroft's School, Woodford Green, Essex

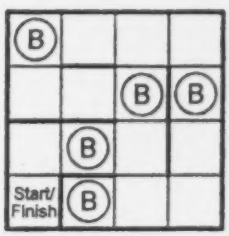
Inspired by his school's award-winning performance in the IEE Micromouse Championships last year, Steve Woolley produced another winner as a competition for SET95 Week in March

When SET (Science, Engineering and Technology) Week appeared on the agenda in my school, someone pointed out the word 'Technology' and asked me what 'we' would be doing. As I am interested in promoting school technology and a firm believer in catching the imagination of children at the earliest possible opportunity, I suggested that we might run a technology competition for our junior feeder schools.

The competition needed to be fun, accessible to children in Years 5 and 6, and to use equipment that our feeder schools would already possess. I therefore chose to devise a series of games based on the programmable turtle called the Roamer (available from Valiant Technology). Our local Midland Bank agreed to sponsor the cost of the event and Valiant Technology agreed to sponsor prizes and to provide free INSET for interested schools. Some preliminary research confirmed that enough local schools owned Roamers, so I started organising the first Bancroft's Roamer Games.

I wanted a variety of activities to entertain and stimulate the children and to cover several aspects of the Key Stage 2 curriculum. Each game was to last 15 minutes and to have a similar format. The games were as follows:

The Maze Game



this represents a balloon.

The playing board of this (and all the other games) is 120 cm square, divided into 16 30 cm squares. The unit of distance is the basic unit of Roamer movement — one Roamer 'length'. The board is marked with heavy lines marking the walls of the maze. Any Roamer crossing the walls incurs penalties. Balloons are fixed at various places around the board and the Roamers are armed with drawing pins at the front. The object of this noisy game is to negotiate the maze, burst all the balloons and return to the start square. Maximum points are scored by teams who manage to achieve this in a single program, but it is more likely that teams will have to rescue Roamers that start to wander through walls or off the playing board, and return them to the start for program modification. Any such contact causes a loss of points.

The Word Builder Game

Q 10	K 5	A 1	U 1
M	E	O	H
L	T	Y	F
Start/ Finish	W	C	P

I have put some letter scores in as examples.

In this game the 4 x 4 grid is filled with letters (apart from the start/finish square) and there are no walls other than the perimeter wall. Each letter is assigned a letter score as in the game Scrabble. The object of the game is to build words of three or more letters and to accumulate the longest and highest scoring list possible in the 15 minutes available. Letters are selected by programming the Roamer to move to a square, then stop and emit a 'beep' to confirm that the letter has been selected. The last letter of a word should be signalled by the Roamer emitted a double beep. After each word the Roamer should return to the start/finish square for further programming, or continue to the next word. Teams who programme Roamer to 'collect' strings of words before returning to the start/finish square receive bonus points. No letter in the grid may be used more than once, and to start with I recommend that players go for short, single words to build their confidence.

The Maths Maze

3	×	1	÷	10	+	2
–	+	+	+	–	+	×
2	+	7	–	8	+	4
–	+	×	+	×	+	+
5	÷	1	–	2	÷	3
⬆	+	+	+	+	+	–
S/F	=	2	÷	6	×	4

This is an example only!

This puzzle is definitely a challenge! The object is to programme a route passing through the number grid using each square once only that produces the largest number when the Roamer return to the start/finish square. The cells of this puzzle are separated by

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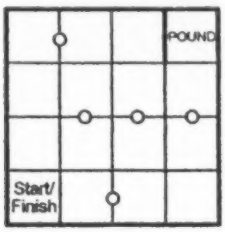
mathematical operators which are used when the Roamer passes through them from one cell to another. If the Roamer runs off the board or needs to be handled for any other reason, then a touch penalty is occurred as usual.

Teams will benefit from starting with short runs through the maze without attempting to use all the squares on their first attempt. The best scoring route obtained in the 15 minutes will count. Routes that do not successfully terminate on the start/finish square — or which use squares more than once — will not count.

The Shepherding Game



o This represents a table-tennis ball.

In this game, one corner of the 4 x 4 grid is walled off as the sheep pound and 'sheep' are represented by tennis balls. The Roamer (best fitted with two pen holders at the front) has to herd the sheep into the pound. This is more difficult than you might think! It is most likely that teams will attempt the task in several sweeps, returning to the start/finish square for new programming after each sweep. As in all games, if the Roamer is touched for any reason (other than when stationary on the start/finish square), a penalty is incurred.

Construction

I made the playing boards from 9 mm MDF and produced the letters and numbers on a computer. The computer print-outs were then enlarged on a photocopier and stuck to the playing boards with adhesive spray. This was a fairly expensive and labour intensive procedure but has produced 20 playing boards which should be durable enough for repeated use. The game boards could be made more simply using lino squares marked with marker pens, or by using one-foot square tiles laid on a hardboard base.

The Event!

Sixteen teams of four pupils from ten different schools came to Bancroft's School and the gym was soon crowded with very enthusiastic Roamer programmers. Each team tackled the four games described above in rotation, so all the teams were occupied all the time. We did take a short break for refreshments, however!

The event was very successful: over sixty children worked with interest and enthusiasm and were very well behaved — as were their Roamers. All the teams were thoroughly absorbed by the tasks and team members clearly co-operated effectively with one another. One of my sixth-form helpers said his team were disappointed that the Games were over — such comments obviously made the effort well worth while. The teachers who accompanied the junior children were impressed and sometimes surprised by how effectively their teams tackled the problems of planning and programming for each task. Several teachers said that they now felt inspired to use the Roamer more extensively in their own school.

The Games concluded with the judging of the best decorated Roamer and the prize-giving ceremony. The judging was carried out by Martin Patterson of the Midland Bank and Kate Hudson of Valiant Technology. All the teams did very well and had a real sense of achievement. The overall winners of a closely fought competition were a team from Selwyn Junior School, Highams Park, and the winners of the prize for the best dressed Roamer were Epping County Junior School, Epping. The prizes (vouchers of £100 and £50 for Valiant products) were awarded by Kate Hudson.

I look forward to repeating the event next year!

Note: Design & Technology Teaching would be interested to hear from other schools about their activities for SET95 — write to the Editor at DATA.

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Bored with Buggies *or* New Ideas for Computer Control

Tim Lewis and John Lee

Sheffield Hallam University

Ready to move on from building buggies? Tim Lewis and John Lee have a range of imaginative ideas for students, including animated baked beans cans and juke boxes

Computer-controlled buggies have served design and technology and science well for many years. However, a detailed analysis of the educational aims and objectives of their use in schemes of work does raise some interesting questions. Where does computer control fit into the philosophy of D&T? What does a typical computer-controlled buggy exercise hope to achieve in educational terms? Confirmation that these questions are realistic was reinforced by comments made in a school by a group of Year 9 pupils who had completed a six-week module of work programming buggies to follow various routes using commercially available software. Most pupils in the group said they liked the work at first but their final comment was: 'We don't know why we are doing it'.

Scrutiny of GCSE coursework projects reveals a paucity of work in this area and suggests a need to consider the effectiveness of computer control work at earlier stages in the D&T education of many pupils. It is pleasing to see that the new Design and Technology National Curriculum has control included at both KS3 and KS4 in the *Knowledge and Understanding* sections but surely the philosophy of D&T is such that it should be of some use in project work to be educationally viable?

Discussions with colleagues teaching D&T in schools revealed that they face several problems in trying to implement this type of work with larger teaching groups across an appropriate age range. The main problems appear to be:

— lack of computers

— lack of interface boxes

— software which takes a long time to become familiar with

— hardware with already limited availability frequently being tied up in individual project work for long periods of time.

Knowing the problems highlighted above, staff and students at Sheffield Hallam University have worked together to overcome some of the difficulties with a particular focus of providing teaching and learning opportunities for control at Key Stage 3. Initially the aim was to put computer control into a framework of designing and making activity so this D&T philosophy could be maintained as part of a computer control module. As work progressed the focus became to:

— resolve the problems of shortage of equipment

— provide interesting D&T activities which embrace computer control but also include design and make work

— plan work which can be delivered within the severe time constraints which often apply to D&T

— consider the effective management of a complete computer control module in a way that ensures that *all* pupils are kept busy with meaningful D&T tasks.

These aims were realised by:

— developing a computer control kit to be used by pupils in project work, but retrievable for use by other pupils

— exploring the use of a range of output devices to be incorporated in the kit

— exploring the use of less resistant materials for use in computer control projects to facilitate rapid assembly of design ideas

— using commercially available software suitable for the age phase which can be learned quickly so results can be obtained with the minimum of problems

— developing design activities which motivate pupils by providing interesting ways of using computer control.

The following outlines some of the ideas which have been developed.

The Key Stage 3 Kit

Several kits are required, each kit consisting of an interface and a range of output devices.

The computer interface

This 'Economy' interface has been designed to provide a cheap output-only interface which can be incorporated in pupil project work and as such, it is the most basic of interfaces. The interface is designed to connect to the 'user port' of Archimedes, BBC Master or BBC model B computers. This can normally be configured to receive/transmit any combination of input/output signals. However, in the interests of simplicity for KS 3 work this provides 'output' only.

This well established circuit consists of an integrated circuit with eight Darlington drivers, one for each of the computer output lines available at the user port. Each channel of the chip is able to carry up to 550 mA and is controlled by the output of the computer user

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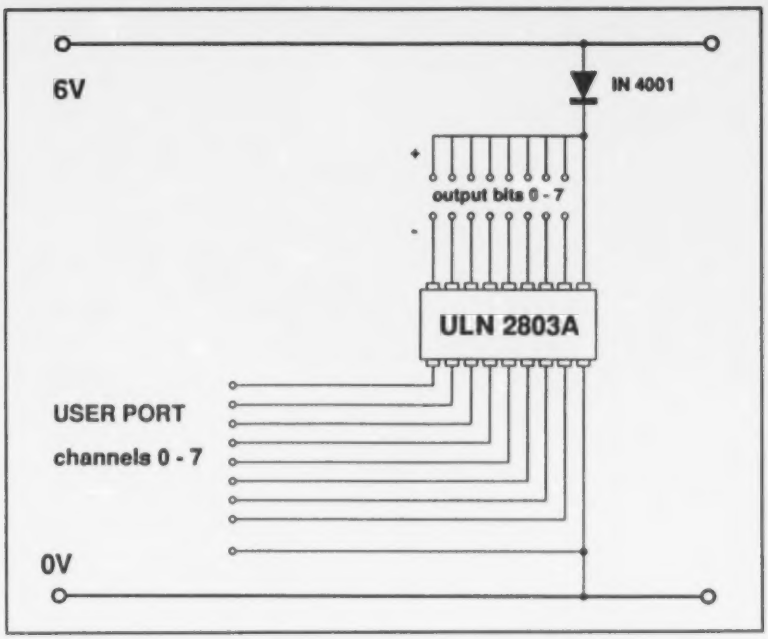
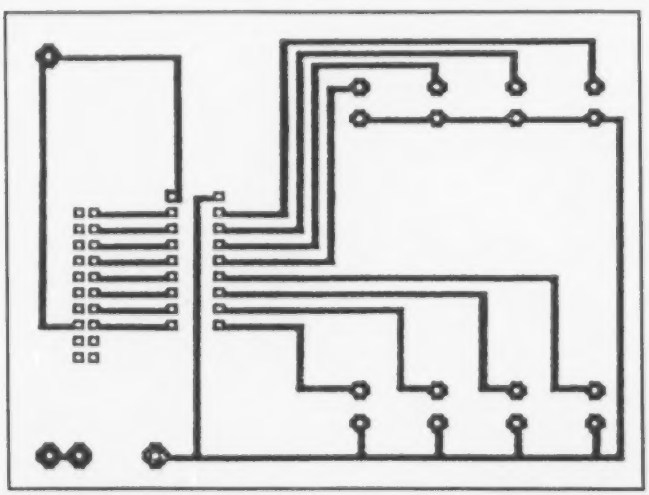


Fig. 1: Circuit diagram of the Interface

port, which has a very limited current carrying capacity. The chip acts as a current 'sink' rather than 'source', meaning that the current flows from the positive supply to 0 V through the chip. As a result, any polarised component such as a light emitting diode (LED) must have its positive terminal connected to the supply and its negative terminal connected to the chip.

The circuit diagram of the interface is shown in Figure 1, the track side of the printed circuit board (PCB) mask in Figure 2, the layout of the board in Figure 3 and the completed board in Figure 4. The circuit is constructed on half a Eurocard PCB. The board is drilled using a 1 mm drill for the chip holder and ribbon cable header and a 1.5 mm drill for the screw terminal connector pins. Solder the chip holder and diode onto the board (note the polarity of the diode), attach both the 20-way insulation displacement connector (IDC) header and the 20-way IDC socket to the 20-way ribbon cable, taking care to line up the arrow on the socket with the red tracer on the cable and the red tracer to the left-hand side of the board. The power source used can be a 6 volt lantern battery. The IN4001 diode on the board reduces the voltage to slightly over 5 volts, making the interface safe to use with the computer. It also provides protection for the interface should a pupil inadvertently connect the battery up incorrectly. We soldered leads to the boards with red and black crocodile clips to connect to the battery. Using battery power avoids problems associated with power supplies such as setting the wrong voltage.

Fig. 2: PCB mask



Output devices

A range of output devices is shown in Figure 5 and includes:

Light Emitting Diodes (LEDs)

A selection of colours can be provided in the kit, the super bright or high-intensity variety being the most suitable. These are pre-assembled with the series resistor (220 ohms) soldered to the lead plus extension wires coded red and black. This was then made more durable by covering it with heat-shrink sleeving.

Light bulbs

Bulb holders with 4.5 volt bulbs are most suitable.

Motors

Small 3-4.5 volt motors work well although this interface only allows them to be turned on and off. The problem of them running too quickly to be of real use in project work has recently been overcome by D&T suppliers (Hindleys, for example) marketing motor/gearbox kits which provide a range of speeds. The cost is around 3.75 for a motor, side frames, axles, ten gears, all nuts bolts and spacers plus instructions to make up the gearbox.

Solenoids

An example is shown in Figure 5. It is a point motor solenoid used by model railway enthusiasts, and is available from model shops. Although these devices are designed to work on 12 volts they work adequately on the 5 volts available from the interface. We used the version which does not incorporate a switch, so

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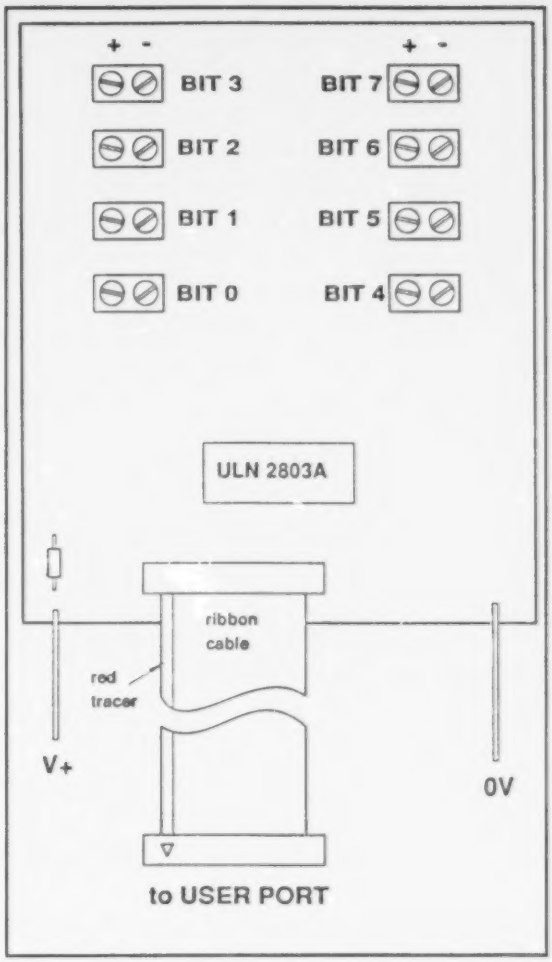

Fig. 3: Layout of the interface

that two control channels are needed to move it firstly in one direction and then back. An output pulse of 0.2 of a second switches the solenoid. These are useful for pop-up actions although the range of movement is limited to about 8 mm.

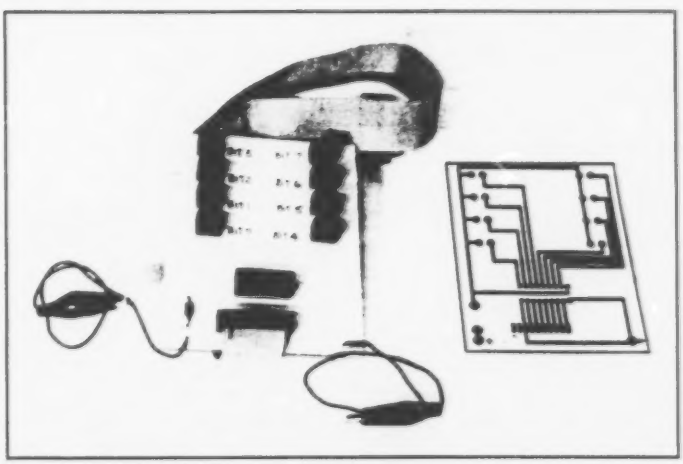

Fig. 4: Completed 'Economy' interface

Noise-making devices

The simplest are buzzers, but particularly attractive for this type of work are the sound-generating chips (obtainable from Maplin Electronics, for example):

FK80B — Musical buzzer which plays seven traditional American tunes; this is shown in Figure 5, and comes complete with piezo sounder and is particularly easy to use

KU60Q — 3-tone piezo buzzer, again a ready-to-use device

LM43W to LM46A — a range of kits providing tunes for celebrations (these need assembling)

UM3561 — Sound-effects generator circuit with police and ambulance siren plus machine gun.

Recently students have experimented with two new sound-generation chips from Maplin's:

AE11M — American Western sounds such as bugle fanfare, horse neigh and pistol shot

AE12N — Animal and farmyard sounds such as elephant, frog, pig and cow.

For use in the Key Stage 3 kit these would need to be assembled onto PCBs or stripboard prior to use with the interface, but they do provide an attractive range of sounds worth experimenting with for use in control projects.

The software

For KS3 control project work we have found CONTROL-IT from The Resource Centre particularly suitable. Versions of the software are available for both BBC and Archimedes computers. They are very similar in operation so it is possible to do this type of work with a mixture of hardware if necessary. Other companies supply similar software.

Materials

Most construction materials can be incorporated into project work of this kind. The main prerequisite is that they can be worked quickly and effectively and as a result, do not divert too much time away from the computer control activities at the heart of the project.

'Correx' lends itself particularly well to this type of work. It cuts easily using modelling knives or scissors and joining is straightforward using brass bifurcated paper clips. Double-sided tape can also be used as long as

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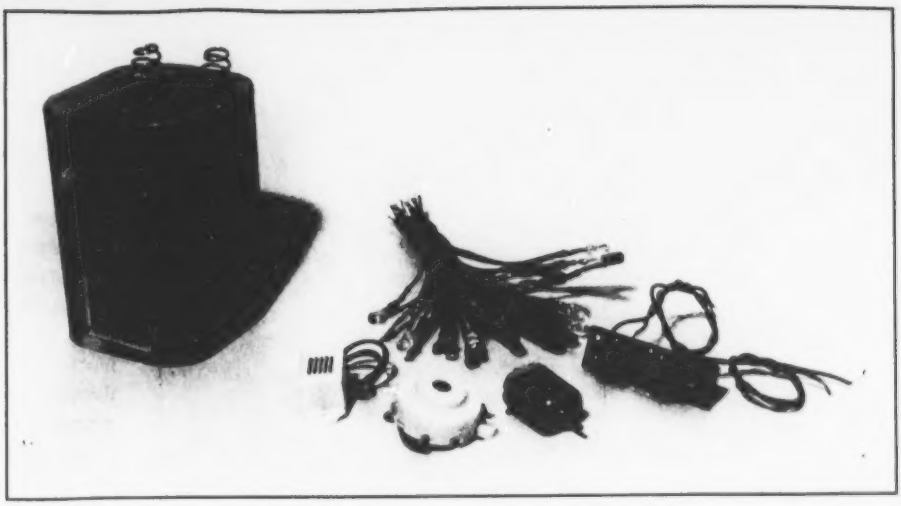
Fig. 5: Output devices



the joint is not put under undue stress. For applications requiring greater strength, good results have been achieved using the adhesive normally used to join plastic waste pipe (care is needed, however, as this is 'sniffable').

Thin polystyrene sheet which can be cut with scissors or knife is also useful as are a range of MDF blocks which can be glued together to support structures.

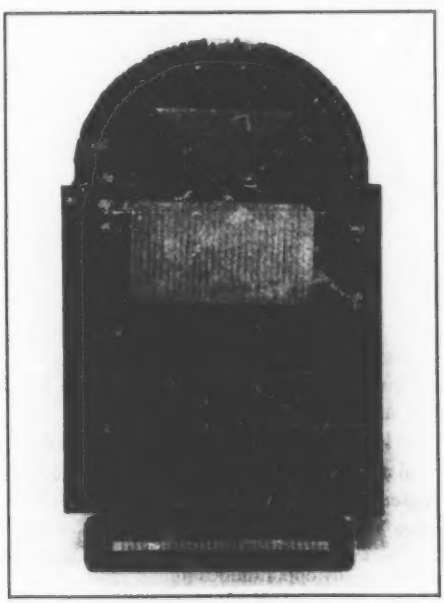
■ Management of project work

Since one of the main objectives for this development work is to use computer control in projects, the efficient management of pupil activities is essential if success is to be achieved. Initially tasks need to be set to overcome some of the problems of equipment shortage, such as:

— learning to use the control software

— connecting different output devices to the interface to explore their uses

Fig. 6: The Juke Box
Fig. 7: Reverse side of the Juke Box



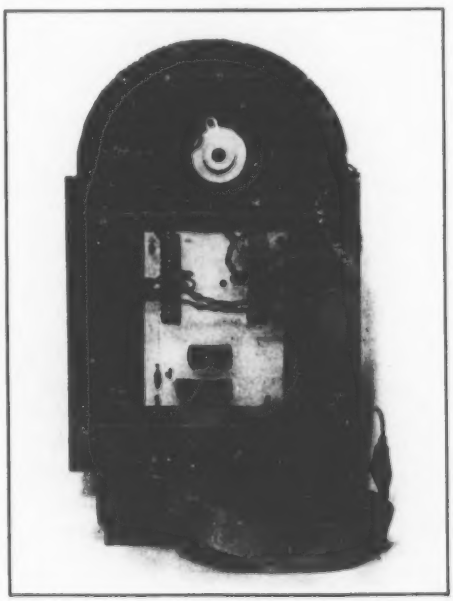


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Fig. 8: BEANZ MEANZ HEINZ

— initial design work for a product which uses computer control
— planning a set of control instructions to be used for the proposed product
— designing the product and experimenting with materials
— making the product using the materials described previously.

By dividing a full group into sub-groups, different tasks can be set for each lesson and queues avoided at computers. Pupils working in pairs or small groups can be beneficial to the designing part of the work but it can also alleviate some of the equipment shortage problems.

Setting the Design Tasks

In common with most school-based design and technology activities, this type of work requires interesting and challenging starting points which will motivate the pupils and thus encourage them to learn more about computers in control. Typical applications could include design tasks focused on 'point of sale' displays or commemorative 'dioramas'.

Advertising provides many opportunities for 'animated' displays in the Blackpool lights tradition, for example;

— fizzy drinks such as Coca-cola
— breakfast cereals
— 'Body Shop' products
— mountain bikes
— Wimbledon tennis
— football matches
— the school logo.

Figures 6 and 7 show a juke box which could be used to advertise 1960s 'Golden Oldies' records. This is KS3 level work and is manufactured using correx supported by MDF blocks. The LEDs are set in holes punched through the correx. The computer control element is to control the LEDs to work in a sequence and at appropriate points, play a tune. The reverse side of this project is shown in Figure 6 with the LEDs and a Maplin American tune player (FK80B) connected to the interface. There can be a considerable variety in the programming sequences to give interesting effects.

Figure 8 shows an example produced by one of the university students as part of the development work. It is an advertisement for beans in which the bean can rotates and spills out the beans which then spell out in sequence BEANZ MEANZ HEINZ, using super bright orange LEDs.

As with most D&T activities, choose the theme or topic well and pupils will respond with interesting ideas, providing opportunities for creative computer control for everyone.

Suppliers

Electronic components:
Maplin Electronic Supplies
PO Box 77
Rayleigh
Essex SS6 8LU

Motor kits and Correx:
J B Hindley Ltd
26B Lion Works
Ball Street
Sheffield S3 8DB

Software:
The Resource Centre
51 High Street
Kegworth
Derbyshire DE74 2DA

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Using IT in Food Technology: why use a computer when baking?

Roy Ballam

Kemnal Technology College

Roy Ballam rues the fact that food technology is lagging behind other areas of technology in the use of IT, and suggests some applications that will enhance learning for pupils of all abilities

Roy Ballam may be contacted by electronic mail on: 100332.1330© CompuServe.com

The argument goes that to be hi-tech you've got to have all-singing-and-dancing machines linked to computers doing CAD/CAM work, as in industry. For technology, you'll find most of these machines working with plastic, wood and metal, although textiles is also being tackled, albeit through embroidery with the POEM and Brother machines.

If, however, the same kind of financial (and political) emphasis was put towards equipment in food (and textiles technology) then surely the same types of activities would happen: high quality products being produced, emulating industrial practices. So why isn't this taking place?

Maybe it is to do with the past life of food technology. I remember myself hoovering the flat at school and then preparing a grapefruit with the correct knife. I also remember the computer being on a trolley and being wheeled out on special occasions — usually to keep some noisy person quiet. Surely this isn't a good use of IT, is it? (I'll come back to this point later.)

Food in the past has been driven by the context of the home, preparing pupils to become good home makers able to cook for themselves. Although these were desirable life skills, computers and IT were rarely mentioned. In other areas of technology, computers were being used, because industry dictated that they should be. BBC computers were controlling lathes and the programming language Logo was being taught to enable pupils to control output devices such as turtles and robot arms.

Food had never really been associated with them in schools, in spite of numerous attempts having been made. Nutritional analysis was one of the first major uses with IT — and still is in many schools today. It offered the chance to enhance pupils' work. It relieved them of mundane tasks and replaced them with a hi-tech alternative. It also meant that all pupils (and all abilities) could now perform this type of analysis (even if this was still dependent on whether the computer was wheeled out of the store cupboard!).

Maybe another reason is because of the traditional gender split in technology. I could go on, but my point is that, where other areas of the curriculum have had time to develop and 'show off' their IT usage, in food technology we are still at the starting place.

What can I do at school?

When people start to talk about how to use IT in food or textiles, the list is nearly always the same — you just *know* that they are going to mention word processing and nutritional analysis. The reason is that they use them and they work. So why not try it yourself? Below I have listed some of the areas in which I use IT in my food technology lessons:

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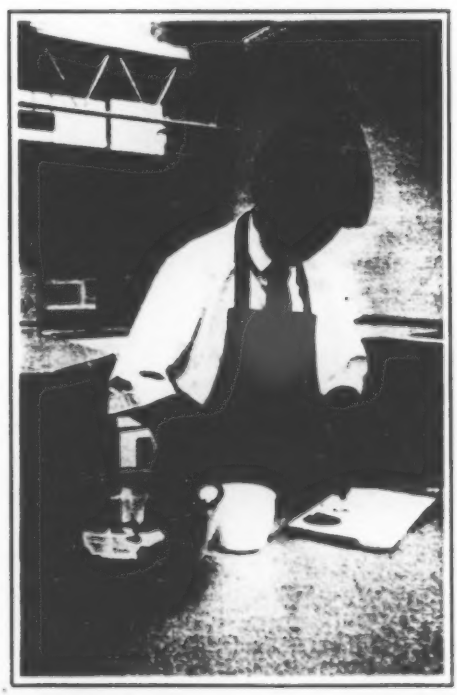
Databases — on nutrition, and others created by pupils
Graphics — to produce data-collection sheets/visual specifications and dimensions
Plotters — to produce sheets for viscosity tests
Cutters — for plastic projects such as moulds
Milling — to produce a former so that it can be vacuum formed e.g. a chocolate/jelly mould
Scanner — to record structures of products e.g. bread structures or egg foams
CD-ROM — for research
Interactive media — MLC Fast Food Diner

I also use IT to support survey work — recording data, making charts, writing — and spreadsheets for costing and recipe modification. For presentation and marketing we have also used hyperstudio.

All these options are wonderful if they are used appropriately by both teacher and pupil. There is no point, for example, in a pupil typing text into a word processor if when printed it still has spelling mistakes. Most word processors have spelling checkers, and these should be used to 'enhance' the work.

It is often a good idea to map out the use of IT in technology work to see exactly what is being achieved through its use. If you then analyse the work being produced, you can see if it has been enhanced or whether it has simply been through an electronic cosmetic change (I believe it is good practice to include this type of information in lesson plans and schemes of work). Enhancement of pupils' work (and therefore achievement) must be the major use of IT, not just to make work look pretty or perform a task in a fraction of the time. Equally, the computer or other elements of IT should not be used simply to keep pupils quiet or 'baby sit' them. Too often teachers may think a pupil is working because they are quite in front of the monitor.



What's next?

It is now possible for pupils to take electronic photographs of their products and store them on the computer. These can then be simply 'cut and pasted' into other documents to produce a manufacturing report or a visual specification (normally on production lines there are photographs showing the final appearance of the product, for example checking that a product surface isn't too burnt or cracked). These cameras (the Apple Quicktake camera and the Canon Ion camera, for example) plug straight into the computer, require no camera film and therefore no processing costs! Other developments include a cheap small camera for making quicktime movies and voice recognition.

Sensory analysis

Data from a star diagram can be transferred and represented on a computer. Using Microsoft Excel (4/5) pupils can enter the data into the spreadsheet, then using a ChartWizard produce a perfect star diagram. Using the computer in this fashion allows pupils to see the relationship of computers and food, and allows them, no matter what their ability, to enhance their work through the use of IT. (Wizards are a new concept from Microsoft packages. They are a step-by-step set of instructions and options which appear on the computer to make the software easier; a few clicks of the mouse and a brilliant star diagram is produced.) In addition a complete sensory analysis package is under development at present by Technopacks. This will allow pupils to research vocabulary, investigate how taste panels are set up and help in the running of a sensory session.

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IT in controlling plastic cutters and moulds

Although not directly involved with the food, using IT to design and make a mould for food can be part of the total assignment. This way IT is being used to control the shape and form of the final product. It is being used to make a precise and good quality tool.

Possible Plastic/Food Projects

- Cheese making
- Biscuit cutters
- Lolly mould
- Chocolate bar mould
- Luxury chocolates
- Jelly mould
- Easter egg/Christmas figure — or any other religious/cultural festival
- Making a die for an extrusion device (icing tube/sausage maker/mincer).

Why integrate a multimedia approach to design?

Apart from the obvious benefits which IT can bring to food technology — as a tool, to increase speed or improve presentation — there are other, less tangible benefits too. Using IT:

- shows pupils how 'resistant' materials help food products
- demonstrates that food design and other areas of design have similar core elements
- brings staff together to a common goal
- helps pupils make products/prototypes that can be used in real life
- promotes team work (teacher and pupil/pupil and pupil)
- increases quality outcomes
- teaches pupils about quality assurance and control
- enables batch production (many products of similar specification)
- helps pupils' understanding and practical experience of working towards tolerances in design.

IT enhancement

If your school or college is lucky enough to have CAD/CAM facilities, these types of assignments could potentially be enhanced through their use. Imagine a pupil sitting down at a terminal, plotting a mould design, modelling it on the monitor and then using the milling machine to manufacture it. Shortly after this the mould/former may then be vacuum formed or used as wanted — simple, precise and of good quality. These facilities are also excellent for those pupils with learning difficulties, including motor impairment.

At present the best pieces of software available are the generic packages (word processors, spreadsheets and databases). All these have common features and pupils learn how to use them in many parts of the curriculum. When it comes to purely food programs the choice is far more limiting, but I'm sure that in the next few years as food technology takes a grip in the curriculum and points to a firm direction, new software will become available.

Conclusion

The use in your school depends on your vision and your willingness for it to happen. INSET may not be available, but sitting down after school with the computer for half an hour can make all the difference. Experiment with the computer programs yourself: you can't break them. There is no mysterious jargon or secret hand-shakes to keep you out. IT is there for everyone to use. It is up to us to become up to date with these developing technologies and to lead the way forward.

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Transferring computer designs to materials

Margaret Beith

Computer drawing packages are increasingly popular with students as an aid to designing, but how do you transfer designs to textiles and other materials? Margaret Beith outlines a number of methods

Many students now have easy access to computer drawing packages and having drawn a design on computer, they need to find a suitable method for transferring their design to the material. (I use the term 'material' because although students will often be transferring designs to textiles, materials such as wood or paper may be the destination for the design.) The problem is the same as it has always been with designs that are drawn on paper, but because of the modern attitudes to designing and making, teachers need to be much more aware of the wide range of methods.

One of the first points students need to be aware of is that when transfer methods result in a mirror image of the design, it is important to have a print-out which is a mirror image of the design. You will need to know if your computer program will allow this before you start, or design a pattern which will not be affected by being reversed.

■ Hand copying

The computer can be used for very simple designs to see which colours work best and these may be easily copied onto the medium that is being used. This is particularly true where the design on the screen is clearly related to the medium that is being used as in the example where paint is simply dribbled onto a coloured paper (see Figure 1) or a design is drawn with a resistant material such as wax and then sprayed or painted with paint or dye (see Figures 2a and 2b).

For more complex patterns, the designs can be copied in encaustic art. The design is drawn with wax crayons on a heat-retaining card. The use of heat can allow the pattern to be altered and the finished design can be left to cool on the card or be transferred to fabric using a hot iron (see Figure 3).

■ Carbon paper

With this method, carbon paper is laid between a print-out of your design and the fabric and the outline is traced using a stylus. This method is suitable for light coloured textiles, wood and plastic and is suitable for activities such as marquetry and pyrography as well as textile design.

■ Tracing paper

In the case of a repeat pattern, one section can be traced onto a block of wood or linoleum to make a printing block for a design (see Figure 4).

Cross-stitch designs, knitting and tufted wool are closely related to the pixels on a low-resolution computer design. Design sheets can be placed over the design and a pattern drawn onto this. This can be done using a

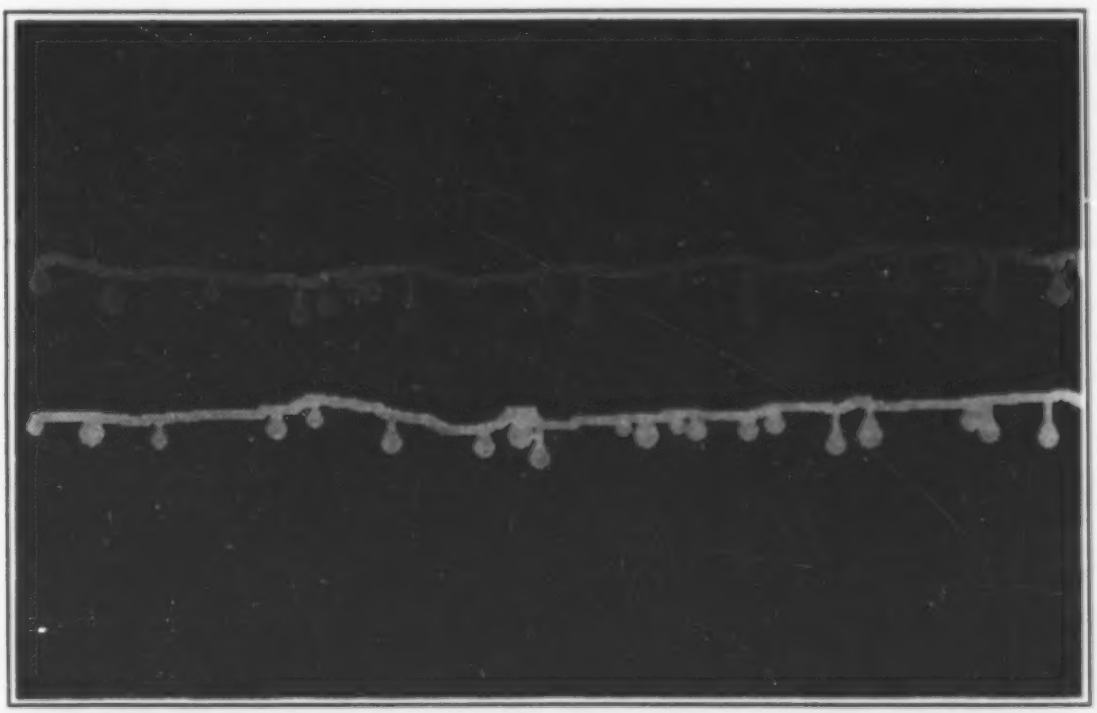

Fig. 1: Paint has been dribbled onto coloured paper

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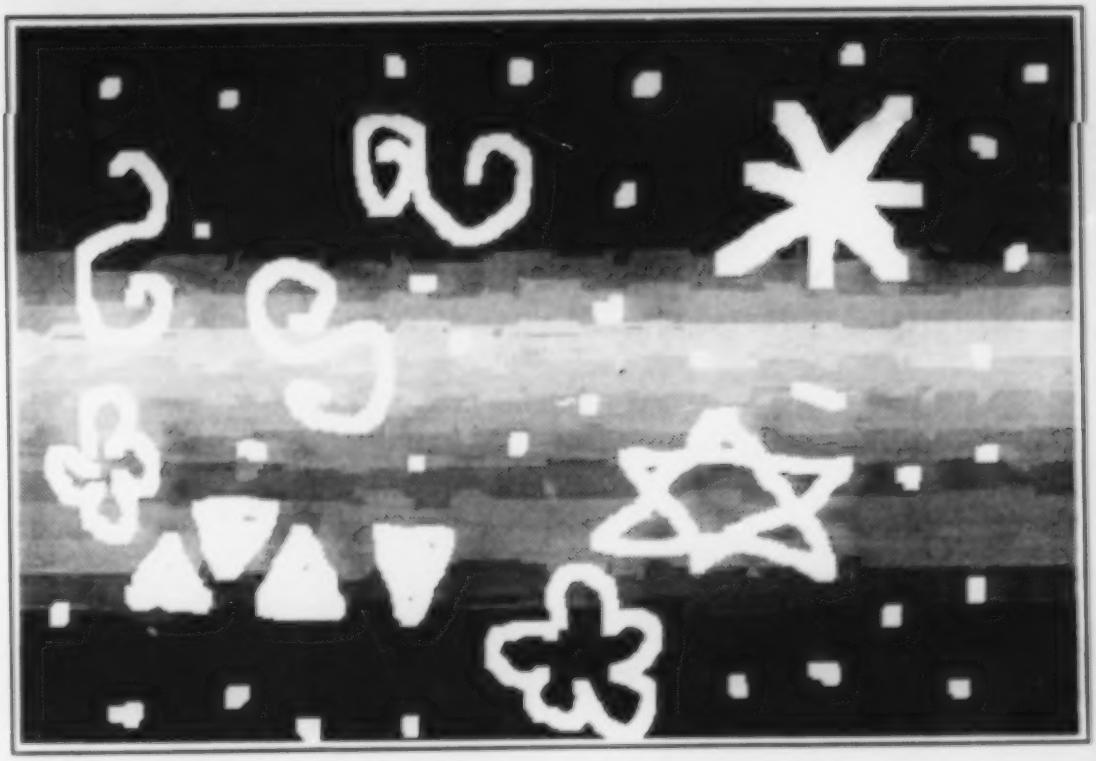

Fig. 2a

Fig. 2b: The pattern has been drawn with wax and then the fabric was sprayed with Deka Silk dye

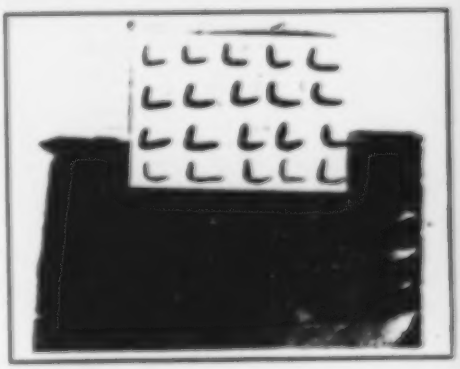

Fig. 3: The pattern was drawn using Crayola wax crayons

Fig. 2c: The pattern has been drawn with wax and then the fabric was painted using Pentel Fabricfun

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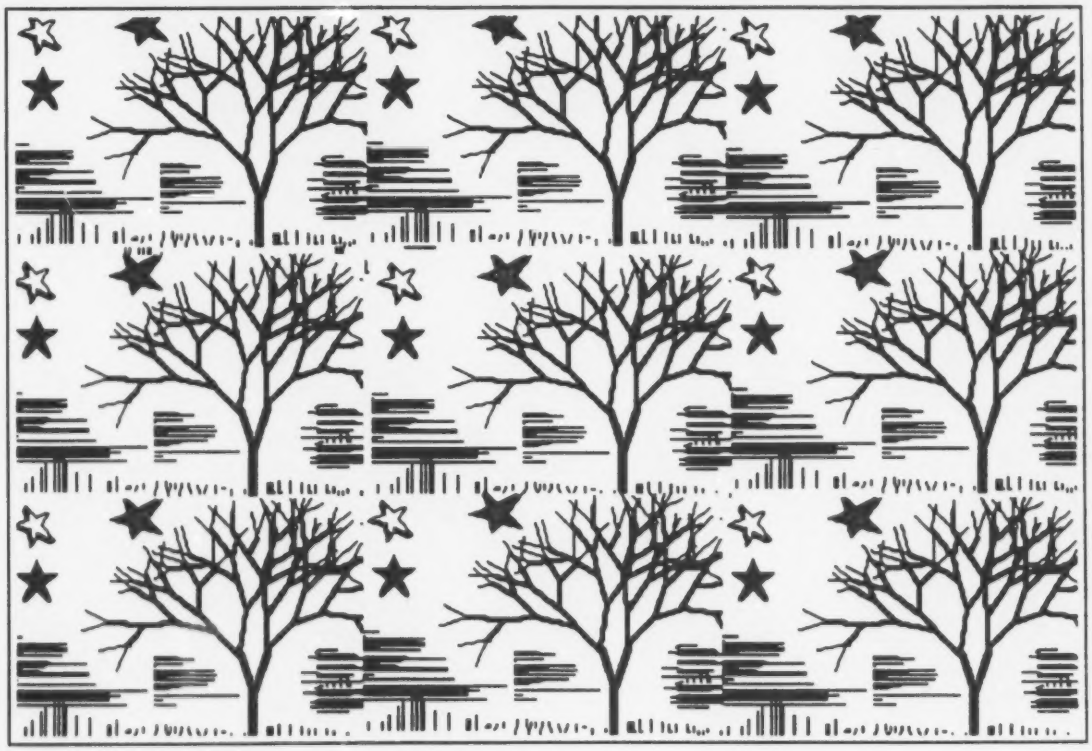


Fig. 4: Printing blocks can also be made by tracing round a computer-generated image

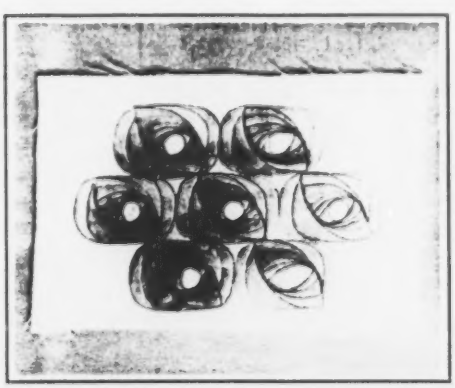
traditional design sheet which is a sheet of squared tracing paper or a piece of software which works in the same way.

■ Transfer dyes

It may be possible to obtain a copy of the outline of the design by requesting a fine black outline with no fill. If you are unable to do this, you can trace round the features of your design using the conventional method.

You may just wish to transfer the outline onto your fabric, in which case you can draw over the line with the dye. If you wish to transfer the whole of the pattern, you need to colour it all in. The pattern is placed onto the material using a hot iron (see Figure 5).

Fig. 5:
A print-out of this geometric pattern was coloured with Deka IronOn, transferred to polyester satin and then quilted



Crayola fabric dye crayons are clean and easy to use. The Deka transfer dyes need to be painted on and have all the advantages and disadvantages that we would normally associated with painting. The wax crayons can be used for transferring designs to textiles and wood and the transfer dye paints can be used on man-made fibres.

■ Textile transfer paper

If the student has a very 'busy' design from a paint program, the use of transfer dyes can be rather tedious and it is better to use a paper called Jet Wear in a dot- matrix, ink-jet or thermal wax printer. The design can then be ironed onto fabric. Unfortunately, the design can only be used once and at nearly £1 per sheet for the paper plus the cost of the colour print-out, this could be a bit expensive for pupils. It is a suitable method for transferring a design to a T-shirt, for example.

■ Templates and stencils

A print-out can be cut out to form a template which can be drawn round; alternatively, an area of the sheet can be removed to give a stencil.

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Direct sewing

The print-out can be applied to the reverse of the fabric using a tacking adhesive such as Pritt Stick. The pattern is then sewn from the reverse by hand or machine. This method is particularly good for work with felt but can be used for paper and plastics too.

If the design is photocopied onto tracing paper, it can be tacked to the front of the textile and embroidery can be worked through it, with the tracing paper being torn away when appropriate. This method is suitable for the more advanced embroidery and partly worked examples using this method can be seen in the Elizabeth Hoare Collection of ecclesiastical embroidery in Liverpool Anglican Cathedral.

Screen printing

Designs can be transferred to a piece of silk before mounting it onto a frame to make a silk screen.

Print Gocco is a new system of screen printing which is particularly suitable for designing and making small cards. Print-outs, of a suitable size, can placed next to a photosensitive stencil in a specially designed machine to produce a screen which can be used in the same machine for printing. The small version of the machine costs about £100 but the flash bulbs and stencils can only be used once each and so the system is only suitable for producing a number of cards. The system can be clearly related to professional systems and the students can acquire some experience of simple colour separations and learn the problems of unit costs for differing sizes of print runs.

Photographing the screen

This gives a durable and pleasing record of designs and is worth the effort for designs with which the students feel particularly satisfied. The photograph can be used as part of an item the student makes from almost any material. It can also be transferred to textile using a version of PVA medium which is marketed under the name of Image Maker.

Colour slides can be projected onto a large piece of drawing paper and a copy can be made. This is particularly useful for large projects. It is necessary to use a SLR (single lens reflex) camera on a tripod to get as close to the screen as possible. There must be no reflections on the screen. This may be achieved by placing the monitor with its back to the window on a dull day. If a blackout is available, so much the better! A flash is not needed.

I have a 13-inch Apple monitor and obtain very good results using 200ASA film with the aperture set at 4.0 and speed at 1/8 second. Valerie Campbell-Harding has had success with 100ASA film, an aperture of 3.5 and a speed setting of 1/8 second. If slides are obtained, these can be projected onto a suitable material and the pattern copied in the medium which is most appropriate for the design.

On-line data transfer

The pattern may be drawn on the computer screen and sent to a sewing machine, knitting machine or weaving loom using appropriate software.

Sources of materials

You can obtain materials from the following suppliers:

Specialist Crafts Ltd, PO Box 247, Leicester LE1 9SQ. Tel. 01533 515051

Encaustic art materials
Fabric dyes and paints
Image Maker
Marquetry
Print Gocco machine and supplies
Pyrography
Transfer Sheets Magic
T-shirts

Jet Wear textile transfer paper is available from Quill Marketing, 11 Hemmings Close, Norwich NR5 9EH. Tel. 01603 748802

Design sheets are available from Craft Creations Ltd, Units 1-7, Harper's Yard, Ruskin Road, Tottenham, London, N17 8QA

Sewing machines and PC Designer software are available from Pfaff (Britain Ltd), FREEPOST(LE6272) Leicester LE5 6ZS

Weaving and knit design programs can be obtained from Harris Looms, Emmerich (Berlon) Ltd, Wotton Road, Ashford Kent

Some of these items may also be available through your LEA adviser or local stockist.

References

Beith, Margaret, *Computer-aided Embroidery Design*, Vol. 1, ISBN 0 9520675 1 X Richard Beith Associates, 1993

Campbell-Harding, Valerie, 'Photographing Designs on the Computer Monitor', *Computer Textile Design Group Newsletter*, Issue Number 1, March 1992

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Textiles: Art *and* Technology
A report of a TVEI Textiles Project

Jill Fitzgerald O'Connor

Some ten years ago, Jill Fitzgerald O'Connor, an independent designer, took part in a TVEI Pilot Project in Textiles in Northumberland; these are her reflections and suggestions on avoiding some of the pitfalls.

Jill Fitzgerald O'Connor can be contacted at Monks House, Woodlands, Hexham, Northumberland NE46 IHR, telephone 01434 604790.

When I was studying to be a designer, at the start of the sixties, I was expected to be able to 'realise' a design, that is, to see it through from sketch to pattern to finished garment. This concept was reinforced by the example of my first boss, who could roll up his sleeves and sit down at a machine to show the sample-machinist exactly how he wanted the garment made up. In due course, when I started up my own business, not only did I have the necessary skills to produce my own sample range, but when I needed employees, I was able to train them in-house. Above all, what I have always found so satisfying about my work is the balance of *creativity* and *practical skills*.

British clothing manufacturing is heavily concentrated in what is known as CMT (Cut, Make, and Trim) for chain-stores such as Marks and Spencer, where there are plenty of opportunities for production technicians but very few for designers. Whilst our designers are internationally acclaimed for their innovation and creativity, there are not enough designer jobs for the thousands of talented young graduates. Yet the industry could improve and be more competitive, if not on price, then on design, if only these college-leavers were more acceptable to the industry. When manufacturers are asked what they are looking for, it is always the same: *the technical skills to realise the designs*.

The TVEI (Textiles) Pilot Project

In 1985, the Government set up a new vocational initiative for secondary schools, funded by MSC (Manpower Services Commission). I was approached by the LEA for the part-time, peripatetic, post of teacher-adviser in fashion/ textiles, to develop a course linking education, training, and employment. My role was to:

— demonstrate skills and techniques to teachers and pupils

— support and assist the teacher in the classroom, as required

— link industry and education

— exemplify and encourage enterprise

and all on the pay-scale of an unqualified teacher!

The two Newcastle city schools assigned to me had very different approaches:

- In the first school, the work was focused on *fashion*, and art and design orientated, with the art and needlework teachers working as a team, preparing the pupils for HE. This course was confidently planned: each pupil was to produce (including artwork and practical) six garments to reflect the different areas of study.
- In the other school, the emphasis was on *textiles* and the school had actually been

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equipped with industrial machines as it was envisaged that girls would go straight into machinist jobs. The course was planned to be flexible, according to the needs of individual pupils.

As teacher-adviser, my role at both schools was to be as a facilitator.

Introduction of the teacher-adviser

A non-teaching adult, in an authoritative technical position, poses a threat to the regular teacher unless the roles are clearly defined. In the same way, when I was put in front of a class, I found the experience intimidating because I had not been trained in class-control techniques. There was also a danger that, unless I had the opportunity to train the teachers beforehand, their inexperience in the new methods would undermine their confidence.

Group size in education is larger than for training in industry, so I was frequently used as an auxiliary, which defeated the object of the project. The best method of working was leading by example: working on new styles and cutting patterns; what really impressed the youngsters was the *speed* at which garments could be created from the resources now available to them, compared with the 'needlework' with which they were familiar.

Creating resources

It soon became clear that what was needed was learning materials that could be quickly applied to the teacher's requirements, and which the pupils would immediately recognise as simple to use, thus disguising the teacher's unfamiliarity in working with them. It was also clear that they wanted to make simple garments for themselves, similar to those they could buy in the shops — casual tops and skirts, in sweatshirting, denim etc.

The fashion blocks

I drafted card templates, from standard bodice blocks, in three styles (see Figure 1). The shapes were so similar to the styles the pupils were wearing, that they had no hesitation in selecting the design they wanted to make. They drew round the template onto plain 'kitchen paper', then compared measurements with their own garments, and extended the block to make their individual pattern. I demonstrated how to use professional equipment (pattern-grader's set-squares, spiked tracing-wheels, and pattern-notchers), first bringing in my own, so that the teachers could evaluate whether it would be advisable to purchase some for the school.

The methods I used were:

— calico 'toiles' (mock-ups for fit and style)

— open-width laying-up for economical usage

— making-up on the flat

— holding work (unpinned) for seaming and easing

— machine-finishing (buttons etc.).

These methods were essential for use with industrial five-thread overlockers and the professional results — declared to be 'as good as from shops' — encouraged the pupils, who wore their finished garments to school.

Design or skill — chicken or egg?

The whole concept of TVEI was *problem-solving*, and the fact that pupils had to think through for themselves the best order of working showed how effective this was. No sooner had they finished one garment, they would want to make another, but this one would be much better, it would be *different*. They quite naturally found that they were beginning to design. By week six I recorded that 'the variety of work, including techniques not deemed within the grasp of this ability level, continues to surprise'.

At the 'fashion' school, there was a group of 'non-drawers' who had looked forward to being able to make garments, but were becoming demoralised through the emphasis on drawing and designing. When finished work was exhibited, there was plenty of lively artwork, but the standard of garment-making failed to reflect this.

Ten years ago, CAD was a novelty; the Technology Bus visited both schools and pupils had the opportunity of hands-on experience, supervised by technicians. The artistic pupils at the 'fashion' school were not impressed, but those who had difficulty with drawing were delighted with the fashion package, which enabled them to design different garments for ready-drawn 'models'.

I demonstrated how technology could be used to do the 'difficult' techniques such as

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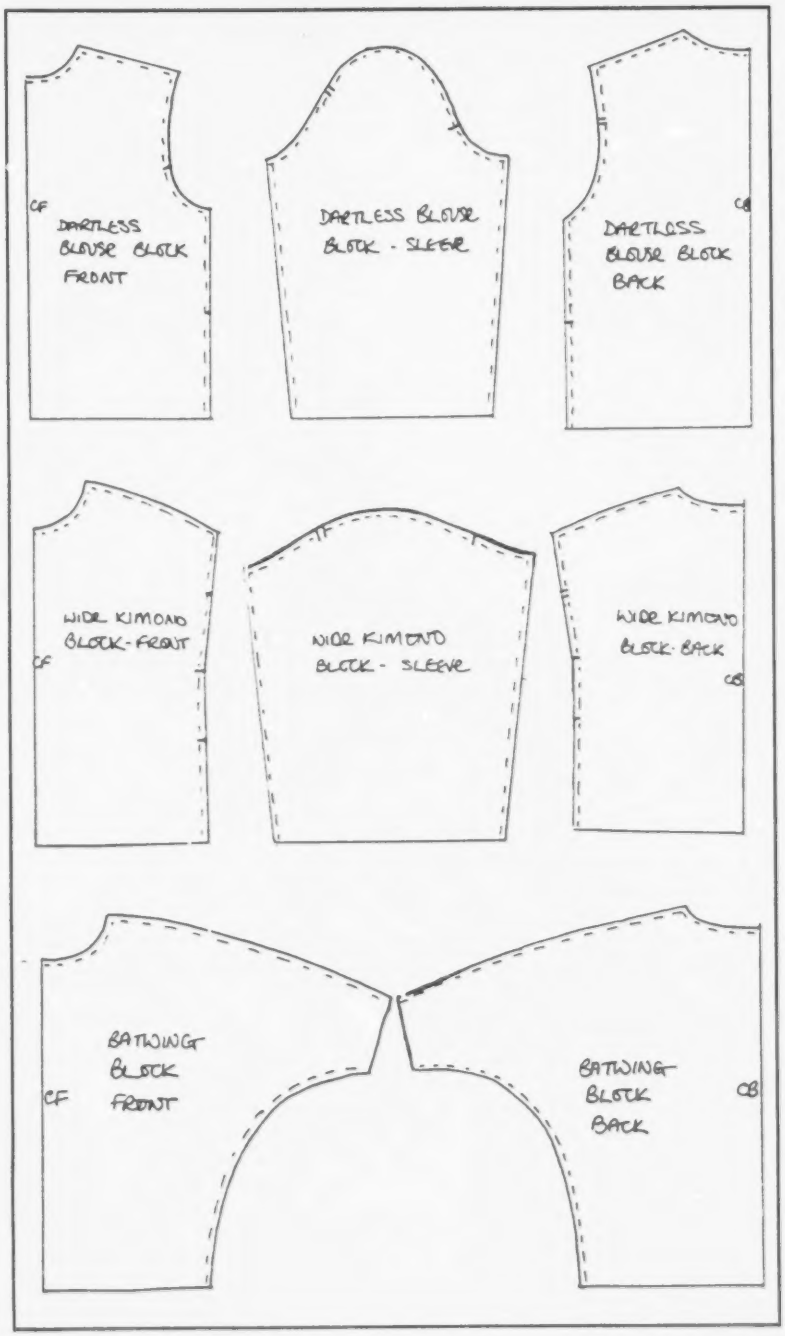

Fig. 1: The Fashion Blocks

lettering, by enlisting the help of a technician to produce a print-out of a selected fontstyle that could be cut to make paper stencils for screen-printing; the end result was a two-colour print for sportswear (see Figure 2).

Enterprise — and competition

In the 'fashion' school, the local Youth Enterprise Centre introduced the concept of enterprise via business plans and organisation structures. Unfortunately, this resulted in serious disagreements between the pupils: one group drifted away from the subsequent 'boardroom' power struggles — they were 'just the sewers'. However, this group turned out to be the power-house of a highly successful and *profitable* range of separates manufactured by the fashion mini-enterprise, and at one point in the hectic Enterprise Week, actually locked the management out of the Needlework Room, to stop them interfering with production!

Competition of a different sort also took place. One of the local M & S suppliers, with a proactive personnel officer, set up a fashion competition for schools in the region, the brief being to create a leisure outfit from jersey fabric supplied by the firm. This was won by a pupil from the 'textiles' school largely because of her understanding of production criteria: a garment must be economic in fabric usage, as uncomplicated as possible in construction yet with attractive features, and above all, it must appeal to the target customer. The pupil not only won a cash prize, but was taken to the factory, where she saw her pattern being computer-graded, and put into production in the training-section.

Links with industry

Apart from begging materials from local factories, we made a number of educational visits. I also made contacts through my status as a designer, with trade papers and textile companies. The climax of this was participation as delegates to the prestigious World of Fashion Conference in 1987, where the teachers were welcomed as pioneering valuable grounding for further training in industry.

This was definitely an objective achieved, largely through the confidence expressed by

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the pupils when they were taken on factory visits. Their familiarity with the machines and techniques also gave them positive attitudes when applying for vacancies, and their 'make-through' skills enabled them to get the more interesting, and better paid, sample machinists' jobs, as well as improving their team-working skills. After our first batch of leavers found jobs, the schools found they were being approached by employers for more of these capable recruits.

Fig. 2: Computer Aided Design. Sweatshirt and running-vest with 2-colour screen-printed logo.

Lessons to be learned

What did I learn from this project? As a new initiative, it contained both successful achievements and some serious difficulties. Many of both were dependent on the specific situations which existed in this area and in the two schools where I was based, but some general observations also came out of the project. Three in particular are worth recording for any school-industry link of this nature:

- The basis for successful designing is the practical craft skill
- It is unreasonable to expect teachers to become experts overnight
- A better dialogue is required between industry and education.

Ten years on

In recent articles, I have read of the concern that trainee-teachers are so lacking in practical skills that there is a risk of them being unable to deliver the National Curriculum.[1] I have conducted a brief survey among fashion/textile students now at colleges into their experience of Art/Design/CAD/Textiles teaching at secondary schools. On the whole, they thought their teachers were skilled and confident, and encouraged them to go into higher education. What was surprising were the numbers of students who studied art to GCSE and A level who would have liked to do more *drawing*. Headteachers were felt to be neutral in supporting art & design subjects, with the occasional attitude that they are more suited to non-academic pupils. Parents were seen as being overwhelmingly supportive, but less than delighted at the prospect of their offspring ending up as machinists, technicians or pattern-cutters.

I am keen to establish what teachers themselves think, and whether they would welcome INSET along the lines of the TVEI pilot. I was recently invited to run a weekend workshop for art and needlework teachers at an enterprising school in another region, and was asked back to see their fashion show. Now, with the popularity of The Clothes Show on television, the whole image of the clothing industry has been revitalised, and schools throughout the country put on their own fashion shows, so why this continuing lack of skills?

Reference

1. See, for example, Tim Lewis's article in *Design & Technology Teaching*, Vol. 27 No. 2.

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Food Technology in the National Curriculum — an Industrial Perspective

Brenda Jamieson

Manager, Home Economics, Sainsbury's

Food Technology has adopted some of the techniques of manufacturers and retailers; Brenda Jamieson outlines the methods used by one of Britain's biggest

Everyone in their ordinary daily life is confronted with the products from a highly developed technologically advanced industry, in the food that they eat.

There are many aspects of Food Technology in the National Curriculum related to food retailing. The introduction and acceptance of a new product, from the first stage of conception to the point of consumption, is a good illustration whereby classroom investigations and evaluations can reflect industrial practice.

New products are developed to reflect the needs of today's society. The new products monitoring service at Campden Food and Drink Research Association (CFDRA) recorded 4,815 new food and non-alcoholic drink products for 1994 — a staggering 92 for every week of the year! Sixty percent of those new products recorded were retailer label (see Figure 1).

Product Development is the systematic process for developing and marketing a new food product from the development of an original product idea to the launching of the product on the market (see Figure 2).

The following statements taken from the National Curriculum Orders for Design and Technology relate to food technology and retailing, from new product development to quality control, to marketing and advertising, and can be delivered through food technology coursework:

Figure 1

New Food and Non-alcoholic Drink Products

Year	No.
1990	2,990
1991	3,233
1992	3,823
1993	4,525
1994	4,815

New Food and Non-alcoholic Drink Products

	1993		1994	
Frozen	662	15%	533	11%
Chilled	2055	45%	2405	50%
Ambient	1808	40%	1877	39%
	4525	100%	4815	100%

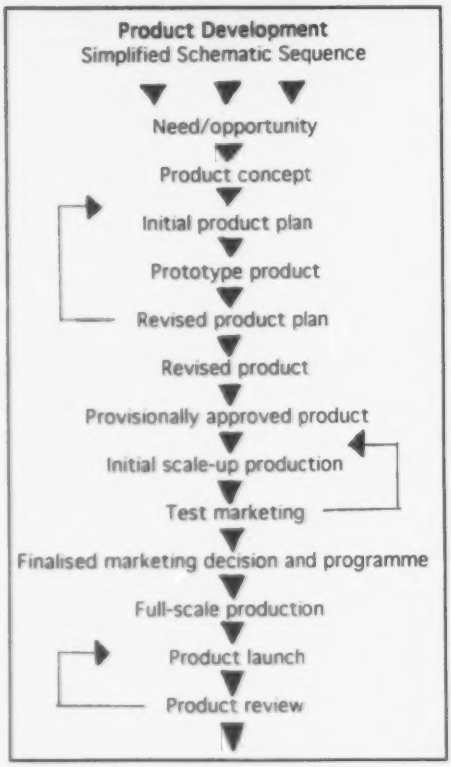

Figure 2

- factors which affect food choices
- organoleptic qualities of food
- comparing and assessing products
- sensory testing (including interpretation of statistical data)
- legal standards
- evaluation of consumer acceptability.

Factors Which Affect Food Choice

Understanding the reason for food choice is a complex field, influenced by many factors (see Figure 3). A knowledge of the factors and how they relate is essential to manufacturers and retailers. A producer must be aware of his potential customers and attitudes to his products as well as the various economic or social factors which influence them when purchasing. Without such information it is impossible to optimise product ranges, successfully create new products or direct advertising to where it will be effective.

Changes in home and society have a major influence on new product developments. Manufacturers have to develop products to appeal to clearly defined market sectors and

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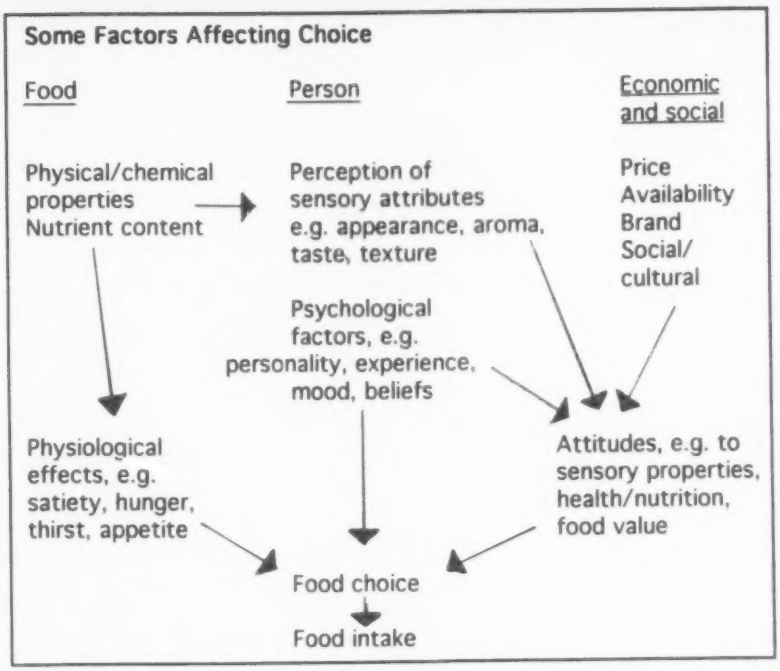

Figure 3

must increasingly think of the circumstances and life styles they are catering for. These are some of the factors to be considered:

- Changing market demographics — falling family size, and changes with household styles of living. Nearly one quarter of all households in Great Britain are one-person households (the increase in the divorce rate has led to more single households and single-parent households). Age ranges with the most change projection are fewer teenagers and under-20s (therefore fewer purchases of hamburgers, cakes, ice creams etc.) and an increase in the 45+ group in the prime of life and peak earning capacity, with higher disposable incomes who are heavy spenders in high-value products.
- Increased number of women in the workforce — more wives and mothers working means less time for preparation of meals and a greater demand for convenience and quick-cook foods stimulated by raising levels of consumer durables such as microwaves.
- Increased consumer spending — the essence of shopping has moved away from bargain hunting, and in its place has come the search for quality. Customers are prepared to pay for convenience and higher quality (e.g. extra trimmed meat, prepared salads).
- Increased travel — increased interest in foreign foods and a greater choice of wine, coffee, cheeses, exotic fruit and vegetables from around the world. This is also reflected in a wide range of ethnic cookery book titles.
- Heightened consumer awareness — increased education has resulted in reduced consumption of high-fat products and an increased consumption of fresh fruit and vegetables. This has resulted in the development of modified foods (such as reduced sugar, salt and fat, or increased fibre alternatives to standard lines) and with 33% of all adults actively trying to lose weight, 'diet' products (weight-watchers' ready meals, for example). There has also been a decrease in the consumption of white loaves and a compensating increase in the purchase of other types of bread, especially wholemeal and soft grain.

Environmental — there is increased concern about the environmental effects of products, with an increasing number of people who choose to eat vegetarian foods, and wider availability of organic products.

Changing lifestyles and food patterns go hand in hand with technological developments. Overall, the effect on food retailing has been the introduction of smaller unit pack sizes, increased sales in ready meals/convenience

Figure 4

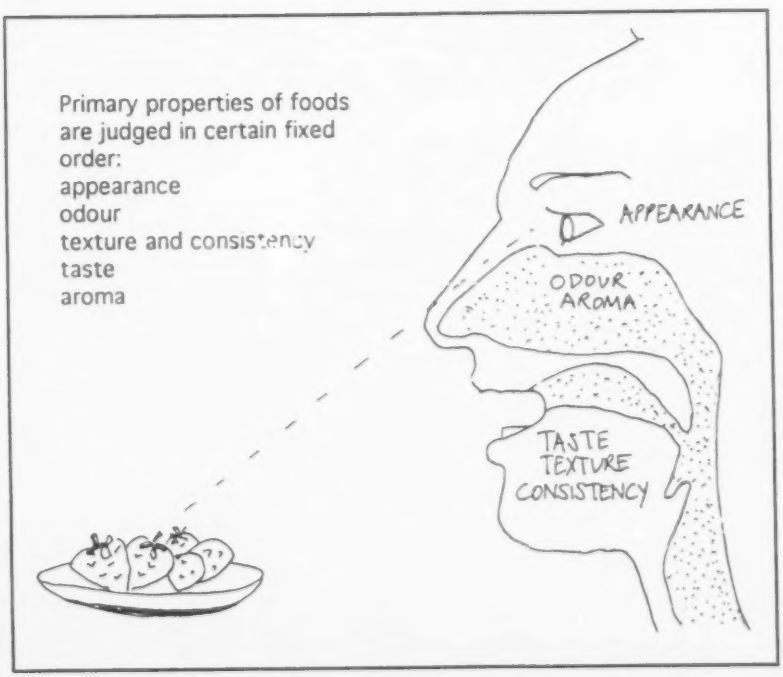

Figure 5

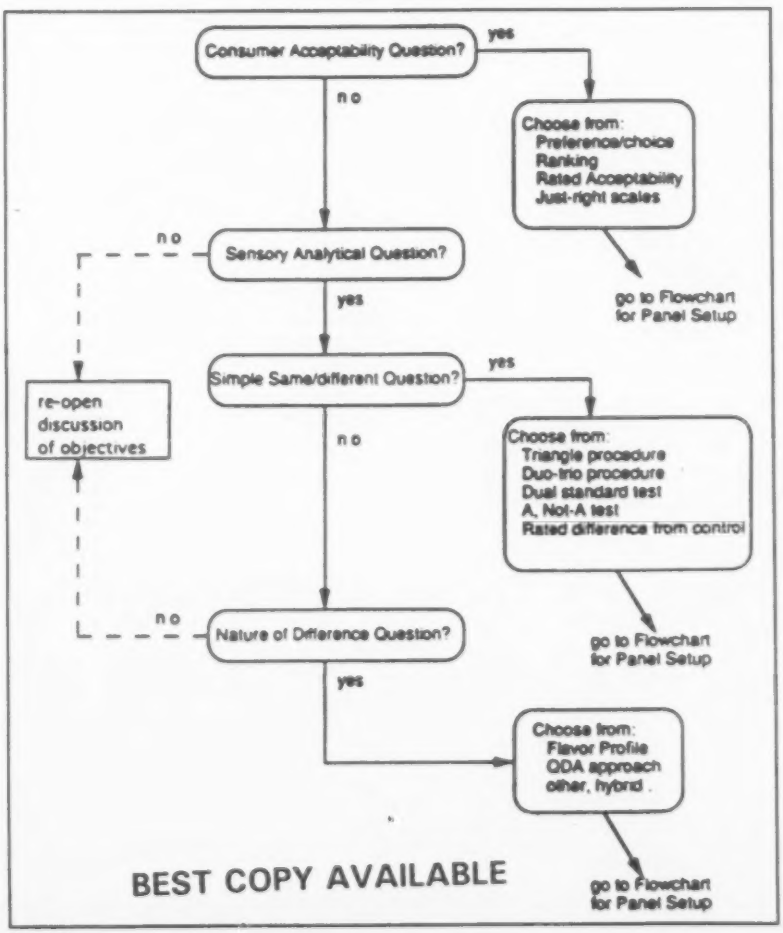

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Figure 6

foods, multi-packs of individual items, quick-cook products, and increased consumption of snack products.

■ Organoleptic Qualities of Food

The sensory quality of food products can have a significant bearing on their commercial success. The consumers' decision to purchase or re-purchase a new product is determined by many factors, and of prime importance are the appearance, flavour and textural quality of the product.

Appearance either succeeds or fails to stimulate appetite. Once the food has been tasted, appearance becomes secondary to taste and texture (see Figure 4).

During a product development programme, many modifications will be made to the product, such as use of alternative ingredients and the selection of different processing products. Each of these modifications may affect the sensory qualities of the product. Evaluation of the organoleptic qualities of a product during development stages results in greater chances of success in the market place.

■ Comparing and Assessing Products

Following assessment of need, it is essential to produce the right commodity. Sensory quality is only one of the many attributes affecting food choice. Apart from the product's appearance, aroma, taste and texture, a few of the intrinsic properties of food which influence acceptability are nutritional value, safety, versatility in use, convenience in preparation and keeping quality. There are also other more subtle factors which influence consumers, including marketing and advertising, and even the brand name, price and availability.

There are two major types of market research (see also Figure 5):

- Quantitative — this includes surveying a representative sample population, usually through the use of a numerically coded questionnaire with a constrained range of answers. Consumer surveys using a carefully worded questionnaire can provide information such as frequency of

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purchase and likely repeat purchase and investigate market variables such as name, packaging and price.

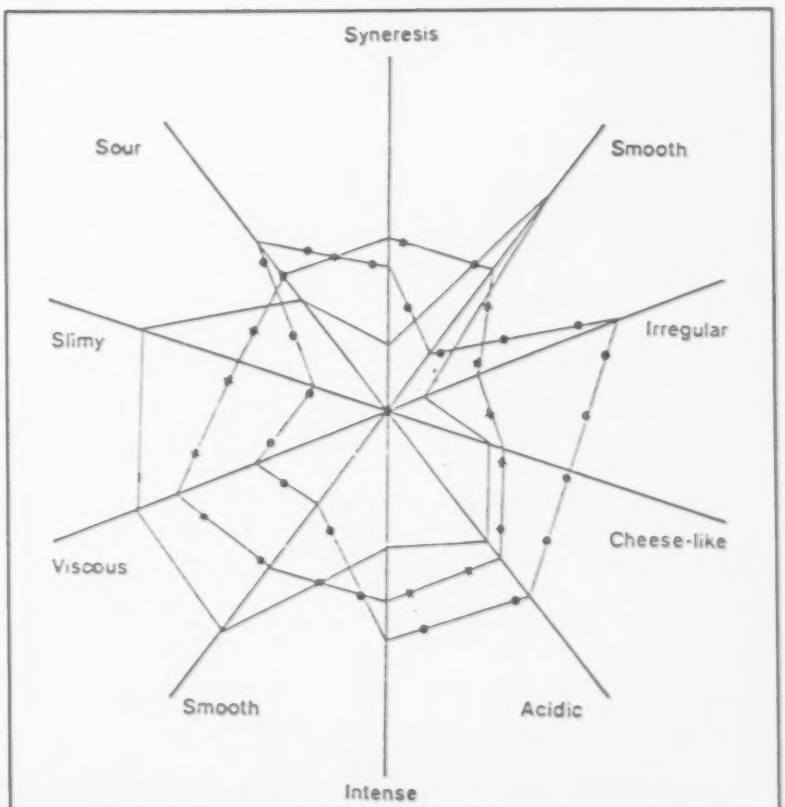
- Qualitative — this includes more in-depth and 'open' questioning, particularly useful for exploring feelings and attitudes. In-depth 'focus' discussion groups provide information on how 'real' consumers think about a product in their home and among their friends. They look at the product from a totally impersonal view, their evaluations are dispassionate and their comments honest.

Sensory Testing

Modern sensory evaluation techniques require careful experimental design to ensure efficient use of the powerful statistical methods for analysis now available in computer packages (see Figure 6). The ready availability of computer hardware and software for data collection, storage and analysis has led to an interlinked computing system:

- Difference testing — this determines whether a product modification such as a substitute of an ingredient produces a perceptible change in the product (to what degree, for example, can fat levels be reduced before the change is detected?)
- Product profiling — for this, panels are extensively trained to score sensory attributes of products. The result is a visual representation of the data in the form of a star diagram or spider's web. Each arm of the star represents a sensory attribute. The mean score for each attribute is plotted with the centre of the star representing the absence of the attribute (see Figure 7).

Figure 7



Attribute profiles of natural yogurts made with three different cultures

Legal Standards

All packaged food sold in the UK should carry labelling which conforms to the Food Labelling Regulations of 1984. The major aim of labelling is that it should be informative (see Figure 8) and it must contain:

- the food name
- a list of ingredients (in descending order of weight)
- the net quantity
- a date mark ('Use by', on highly perishable foods located in chill cabinets, and 'Best before' on all other products)
- storage conditions
- the business name and address of the manufacturer or seller
- the country of origin
- instructions for use.

Legal standards also encompass advertising.

Advertising

The Advertising Standards Authority controls the content of print and cinema advertisements and stipulates that advertisements must be legal, decent, honest and truthful. Advertising may be classified as:

- informative — to generate awareness of a new product in the market place
- competitive — to protect against competition
- persuasive — 'lifestyle' advertising
- corporate — to give an image of quality and innovation, and aimed at long-term customer loyalty
- generic.

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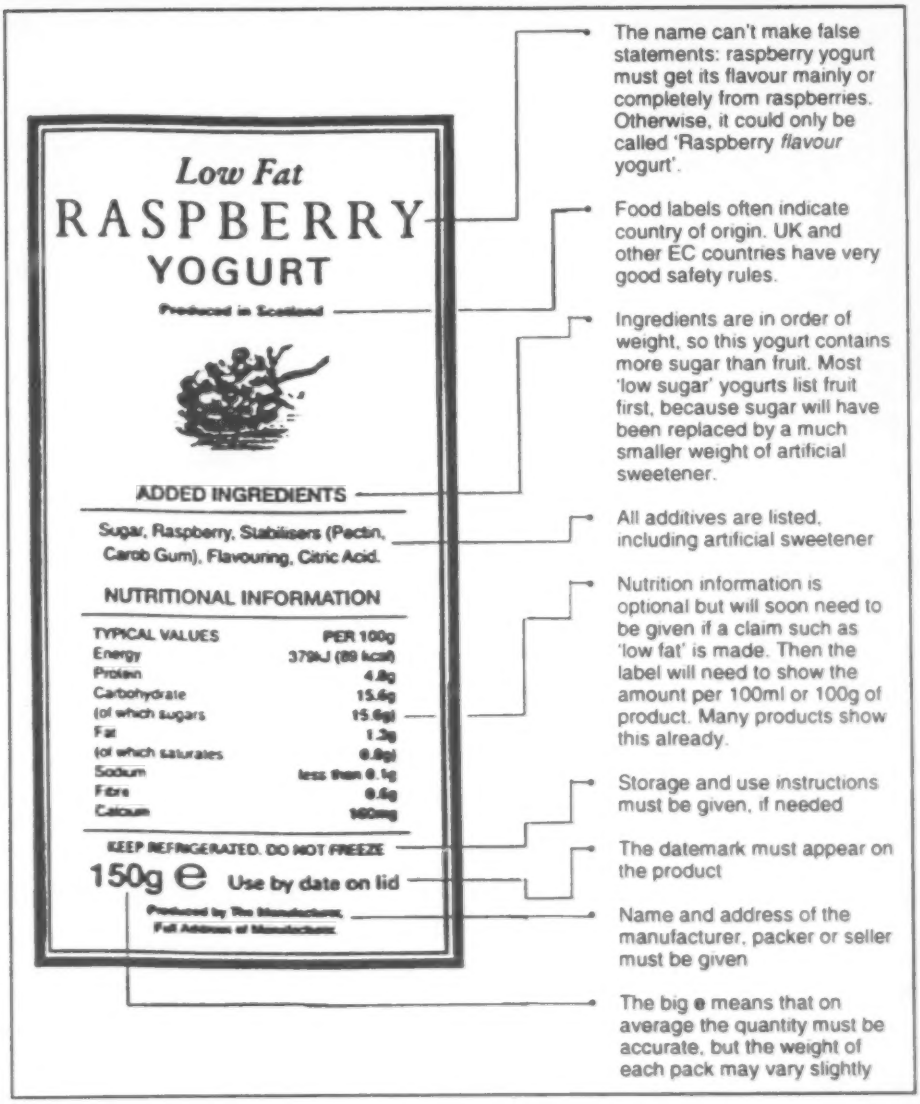
Figure 8


Low Fat
RASPBERRY
YOGURT
Produced in Scotland
ADDED INGREDIENTS
Sugar, Raspberry, Stabilisers (Pectin, Carob Gum), Flavouring, Citric Acid.
NUTRITIONAL INFORMATION
TYPICAL VALUES PER 100g
Energy 379kJ (89 kcal)
Protein 4.8g
Carbohydrate 15.6g
(of which sugars 15.6g)
Fat 1.2g
(of which saturates 0.8g)
Sodium less than 0.1g
Fibre 0.6g
Calcium 160mg
KEEP REFRIGERATED. DO NOT FREEZE
150g e Use by date on lid
Produced by The Manufacturer,
Full Address of Manufacturer
The name can't make false statements: raspberry yogurt must get its flavour mainly or completely from raspberries. Otherwise, it could only be called 'Raspberry *flavour* yogurt'.
Food labels often indicate country of origin. UK and other EC countries have very good safety rules.
Ingredients are in order of weight, so this yogurt contains more sugar than fruit. Most 'low sugar' yogurts list fruit first, because sugar will have been replaced by a much smaller weight of artificial sweetener.
All additives are listed, including artificial sweetener
Nutrition information is optional but will soon need to be given if a claim such as 'low fat' is made. Then the label will need to show the amount per 100ml or 100g of product. Many products show this already.
Storage and use instructions must be given, if needed
The datemark must appear on the product
Name and address of the manufacturer, packer or seller must be given
The big e means that on average the quantity must be accurate, but the weight of each pack may vary slightly

There is an important difference between *brand* advertising to encourage shoppers to buy a particular product, and *retail* advertising which uses products to attract potential customers to purchase a variety of items ('shopping basket').

The choice of media for advertising is determined by a number of factors:

- Target audience (to reach housewives, women's magazines or TV AM might be appropriate, whereas to reach business people, a broadsheet newspaper, or TV advertising during *News at Ten* or *Question Time* might be better)
- Advertising budget
- Marketing mix — television is the most powerful and fastest growing advertising medium (and claims 32 percent of advertising expenditure); radio advertising has also increased but only claims about 2 percent. Although advertising in the press has declined it still retains the largest market share (62 percent); cinema advertising is highly targeted with 60 percent of cinema audiences aged between 18 and 35 years (see Figure 9).

Promotion includes all those activities which are designed to improve customers' awareness and understanding of the product. Advertising is the most obvious and directed method of promotion, but special offers, free gifts, competitions, merchandising, personal selling and publicity also play an important role.

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Figure 9

ADVERTISTING

*	Television	32%
*	Radio	2%
*	Press	62%
*	Cinema	2%
*	Posters	2%

"BELOW THE LINE" ADVERTISING

* Direct Mail
* Competitions
* Sponsorship
* In-store tastings
* Point-of-Sale Advertising
* Door-to-Door drops

Figure 10

Name.....
Date .....
Product .....

Please taste this sample and indicate how much you like or dislike the product

..... Like extremely
..... Like very much
..... Like moderately
..... Like slightly
..... Neither like nor dislike
..... Dislike slightly
..... Dislike moderately
..... Dislike very much
..... Dislike extremely

Please comment why you do or do not like the product
.....
.....
.....

Please press the indicator light switch

Thank you for your help

Evaluation of Consumer Acceptability

For a producer or retailer it is essential to harness all the efforts of new product development into goods and services which satisfy the needs and desires of the consumer. Consumer tests are essential to assess the potential acceptability of a product. The actual consumer test chosen will depend on the type of product. It is important to select the appropriate consumer test in order to answer the objective:

- Consumer preference measures the appeal of one product when compared against the other. If we wish to know only which product is preferred, paired comparison or a ranking test may be chosen. These involve the consumer selecting the preferred product, or awarding the products in ascending order of preference.
- Consumer acceptance measures the degree of liking of individual products. To evaluate acceptability, hedonic scales are often used. The hedonic test directly measures the degree of liking or acceptability of products. A typical 9-point hedonic scale would consist of descriptive words such as 'Like extremely' (9) to 'Dislike extremely' (1) (see Figure 10). For children, picture scales are often more appropriate.

Summary

Consumer needs are constantly changing and the pace has accelerated in recent years. Food manufacturers must constantly review their product ranges to keep pace with sophisticated taste requirements.

The demands made for more variety and higher quality will be met by an array of powerful technologies, related to rising educational standards, to meet the demands of shopping and eating in the twenty-first century.

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The Teaching of Food in the English and Welsh School Curriculum

Marion Rutland

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Marion Rutland has been conducting research into the changes taking place in the teaching of food, and looking at the issues of gender, status, work with the less able, and links with the food industry; these are some of her findings

Many changes have taken place since food was first taught in the school curriculum in England and Wales one hundred and fifty years ago. During this time a range of titles have been used to describe the subject area where food was taught. These have included Domestic Economy, Household Science, Housecraft, Domestic Science and Home Economics.

A preliminary historical literature search of the teaching of food up to the early 1980s identified three issues of concern: gender, status, and an association with the less able. These were areas in which changes in the teaching of food have been most apparent. The impact of the introduction of National Curriculum Technology was then considered, including The Proposals of the Secretary of State for Technology for ages 5 to 16 in England and Wales (DFE, 1992). This document highlighted a fourth issue: it proposed a swing in emphasis away from the teaching of food in the context of the home towards developing food products and commercial food technology. It was suggested that there should be stronger links between the teaching of food in schools and the food industry.

Gender

The origins of the teaching of food in English and Welsh schools were directly related to raising basic living standards (DES, 1978) and training children for low-paid future employment. Food preparation and other household duties have a long traditional association with females. The Education Code of 1897-8 stated it was responsive to the idea of a modifying the curriculum to fit girls for their future life — an attitude which continued well into the twentieth century. Even the range of roles undertaken by women during the 1914-18 war had little effect on attitudes. A Circular on *Advanced Courses in Secondary Schools* (Board of Education, 1919) suggested the curriculum in girls' schools was too closely modelled on that of boys. This theme continued in the Hadow Report (1926), the Spens Report (1936) and the Norwood Report (1943). The emphasis for girls should be to make them aware of their future roles as wives and mothers and potential makers of homes.

It was not until the Crowther Report (1969) that these attitudes and values, which had influenced the teaching of food in the school curriculum, were challenged. The report was the first to note that radical changes in the structure and way of life of the population had affected the lives of women. Women would not spent all their life bringing up children. Families were smaller and they had a longer, healthier life expectancy. Despite this, the Newsom Report (1963) emphasised that girls would be ultimately responsible for running a home and so needed a different education.

The Sex Discrimination Act of 1975 was a landmark in the provision of a common education for girls and boys. The Equal Opportunities Commission (1980) commented that it was no longer possible to exclude pupils from any course on the grounds of sex. Pupils of both sexes should have access to all courses, including ones traditionally the preserve of boys or girls. Lawson (1993) argued that since its conception home economics, including the teaching of food, had been regarded as women's work within a family focus. He saw a need for increased flexibility by these teachers to establish a new direction and identify the key areas to retain and develop.

Status

A number of writers have observed that the role of preparing food, as with other traditional roles in the home, generally has a low status. Riggs (1992) commented that even today there is an underlying belief that matters related to the home, such as food preparation, are a low status area of knowledge. The 'practical' subjects, including the teaching of food, have since the last century been considered to be of a lower status than more academic subjects in the school curriculum. In education there has been a long term, deeply rooted philosophy that only verbal or propositonal knowledge is of real importance. Practical or procedural knowledge is of secondary importance.

Association with the Less Able

The teaching of food has, since its introduction into the pauper schools and the state elementary system, traditionally been associated with young pupils and a basic utilitarian or vocational education.

The teaching of food was introduced into the private and secondary sector in the latter half of the nineteenth century. Teachers in private schools thought that 'Housecraft', including the teaching of food, was a suitable subject for

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the least intelligent who could not be interested in more academic work.

The traditional teaching strategy used in the teaching of food was 'instruction'. This teaching style is associated with 'training' and the development of routine, mechanistic skills and distinct from 'education' which involves a body of knowledge or concepts (Corson, 1991). It was a teaching style that linked the teaching of food to the less able pupil, considered not able to combine 'thought with action'. Newton (1990) and Eggleston (1992) agreed that the craft subjects, including food, focused on the mechanical drill of useful practical skills.

The introduction in England and Wales of new General Certificate of Secondary Education (GCSE) examinations syllabuses for sixteen-year-old pupils in 1986, brought about changes in teaching styles. In the teaching of food, design briefs based on problem solving and an investigatory approach were developed for the full ability range of pupils. Nuffield-based courses in the early 1980s developed a more scientific investigative approach to practical food-based activities. However, despite these developments, the emphasis in the teaching of food was on content related to the home (DES,1985), unlike Craft Design Technology (CDT) where the emphasis was on the process of designing practical solutions and creative problem solving (DES,1987).

Links with the Food Industry

There was a no reference to the area of home economics, where food was traditionally taught, in the documents leading up to the introduction of the National Curriculum in England and Wales. However, the document *Design and Technology for ages 5 to 16* (DES,1989) listed home economics as a contributory subject for the development of design and technology capability under National Curriculum Technology. The emphasis was to be the design process, identifying needs, generating ideas, planning, making and testing to find the best solution (DES,1990). There was much debate as to how the whole area of home economics could be accommodated within Design and Technology, though examples from food technology were cited.

The Proposals of the Secretary of State for Technology in England and Wales for children aged between 5 to 16 years (DFE, 1992), included food as a material to design and make good quality products fit for their purpose. This approach required a change of emphasis from domestic food preparation to commercial production or food technology. An attempt was made to identify the knowledge and skills of food technology needed by pupils to develop and make food products.

Research Method

It was decided to investigate the four issues identified through a piece of small-scale in-depth research involving twelve people based in education and six working in the food industry. Qualitative research methods were chosen because they were able to provide a theoretical framework that focused on social processes, including attitudes and values. The framework required for the research needed to be flexible and not too rigid, to prevent a commitment to preconceptions that could not be modified.

The use of an interview was considered a useful tool for this study, as it involved collecting data through direct verbal interaction between individuals, where a relationship could be quickly established. The interviewees were not all used to educational terminology, so it was necessary to adapt and explain the language and make it more appropriate for each individual.

A questionnaire using attitudinal measurement could be used to gain a larger sample of responses. However, a questionnaire at this initial stage could have alienated people and made them defensive, either through a lack of sympathy with the questions or a lack of understanding of the terminology used. Interviews could be seen as phase one in the research exercise, leading to a further extension of the study through a postal questionnaire, based on attitude scales, for a larger sample group.

Interviews allow in-depth investigation but one disadvantage they have is that they are prone to subjectivity and bias on the part of the interviewer (see Cohen and Manion, 1984). To avoid this, the people chosen had considerable experience of working with food in a variety of educational and commercial establishments. Some were known by the interviewer, some were not.

Each interview consisted of five questions. The first three questions focused individually on

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gender, status and an association with the less able. They asked for the opinion of the interviewee regarding perceived changes, with encouragement to justify their responses. Question four was concerned with changes in the teaching of food that the respondent perceived to have happened already and changes they would like to make. Question five was in two parts and was specifically concerned with the government document (DFE, 1992) and the suggested change of emphasis from food in the domestic context to food technology for commercial production. Part one asked for further comments if links with industry had been already mentioned. Part two was used to explore why some interviewees had made no reference to industry in their previous answer. A pilot was carried out and some questions reworded to aid understanding. Each interview was tape recorded and later transcribed.

Summary of main findings

There was agreement that the study of food is appropriate for both males and females. However, attitudes and values in society to traditional role models are changing slowly. Traditional attitudes remain, particularly with experienced educationalists, regarding the relationship between food and females.

It was considered that the status of food in schools has changed. Some interviewees thought, however, that the status had oscillated due to lack of direction and an unwillingness by some to change entrenched views. It was thought that food had a higher status where it was food technology and a major focus in Design and Technology within National Curriculum Technology. However, there was still confusion regarding a justification for the inclusion of food and where it should be delivered in the school curriculum.

It was thought that the teaching of food has potential for pupils of all abilities, but it was noted that there was a need for differentiation to ensure progression across the full age range of five to fifteen years. It was emphasised that work with food had the potential to interest, motivate and offer unique opportunities to pupils.

It was noted that some food teachers lacked understanding and experience of the food industry and are not aware of the potential of teaching food product design and development. It was thought that changing life styles in society and the increased use of commercially prepared food in recent years make it unrealistic to challenge the food industry. However, links between schools and the food industry would be beneficial if schools were to teach food technology. They would help teachers and pupils develop an understanding of food product development.

Suggestions for the future

It was considered that outdated attitudes of experienced teachers and senior people in education, regarding the relationship between food and gender, should be challenged. Food should not be taught only by women and restricted to the context of the home. It should be taught by both men and women through the commercial setting of food technology, or food product development. This would improve status by creating a new image, as food technology and food technologists.

It was felt that there was a need to clarify why food should be taught in the curriculum. It should be established as the new subject of food technology within National Curriculum Technology, where it will be compulsory for all pupils. The change of image away from the domestic environment and the traditional female roles would improve status. It is important that the organisations representing food technology should clearly represent this view and help educate teachers, schools and parents about the true nature of food technology.

It was recommended that a framework for the teaching of food technology should be created to achieve sound learning outcomes. This should include the concepts, knowledge and skills required across the full age range. A range of examinations appropriate to pupils of all abilities and interests would be needed: examinations which provided access to a range of careers and courses related to the food industry. The potential of work with food to motivate and interest pupils should be recognised. Food technology is able to offer pupils unique opportunities as a personal preparation for adult life and on a commercial level.

Schools and teachers of food technology should continue to develop links with the food industry through industry placements, linked projects and the involvement of Adults other than Teachers (AOT). Courses in food

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technology would enable pupils to follow a wide range of careers in the food industry.

Implications

The research indicated that the teaching of food in schools in England and Wales has moved a long way since it was first introduced over one hundred and fifty years ago. At that time it provided girls with a basic training in cookery skills to feed their families or gain low paid employment as servants. Instruments of change have included equal opportunities legislation, new examination systems, the introduction of The National Curriculum, changes in lifestyle affecting the tradition role of women and the increased use of commercially prepared food products.

A major implication for schools in England and Wales relates to a need for specialist food technology teachers. It is important to convince food teachers at present in schools that food technology is not completely new; much of the food-based knowledge and skills taught in the past will still be included. Rather it is a change of approach from a domestic focus towards commercial food product development for a variety of contexts and groups of people. The 'needs' of individuals within the family unit will still be addressed in the wider context of the food industry.

In-service courses are needed to help teachers clarify the relationship between the knowledge and skills base of food technology, the design process and food product development. Teachers would learn the sensory and evaluation techniques and knowledge of basic food science essential to teach food technology. Individual schools are not able to cope with these demands and additional support and funding are required.

The training of new specialist teachers of food technology, not necessarily with the full knowledge and skills of the home economist, is important. Higher Education needs to consider how this can be achieved. Primary design and technology teachers require a breadth of knowledge, understanding and skills in design and technology, including food technology. Secondary, specialist food technologists will either gain their specialist knowledge on undergraduate courses, including qualified teacher status, or from a food-related first degree followed by postgraduate courses. It can be argued that as technology teachers they should have a wider breadth of knowledge, understanding and skills in design and technology. There is a need to address this issue and consider if this is desirable and if so, how it could be achieved.

An interviewee from the food industry indicated that there was a need for a general framework of knowledge, concepts and skills for food technology. Three headings physical/chemical properties, sensory properties and nutritional properties — were suggested. Following the interview, these headings were used to draft the chart 'Food Technology' for pupils across the full age range five to sixteen years (Figure 1). This chart was used later as a basis for discussion and evaluation.

There are countries, other than England and Wales, where the school educational system is under review and going through a period of change. Ferguson (IDATER 94, 1994) discussed the development of technology education and the structure of education in New Zealand. He reviewed the background of social and economic reforms and changes that have influenced the decision to establish technology, including food technology, in the curriculum as a new essential learning area. It was noted that further research projects in New Zealand into teachers' perceptions of technological education and ways in which teachers can enhance pupils' technological capability would influence future developments. Teacher development and funding for facilities and equipment would be a government issue.

The present research was confined to England and Wales, where it was concluded that though some changes in the teaching of food in schools have already taken place, others are still required. Further research is also needed into such issues as subject content relationship with other subjects (notably science) and progression. Home Economics does not exist within the National Curriculum and food is now delivered as food technology within Technology, with a change of emphasis from food in the context of the home to food product development in a commercial setting (NCC, 1993; SCAA, 1994; DFE, 1995). However, it can be argued that as in New Zealand, teacher development and support is needed if existing food teachers are to deliver food technology successfully. New policies and courses are needed for future technology teachers, including teachers of food technology. George

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FOOD TECHNOLOGY

	Physical/Chemical Properties	Sensory Properties	Nutritional Properties
Key Stage 1 (ages 5 - 7)	Personal safety and hygiene when handling food Measuring foods - simple weighing Using tools to cut, chop, peel, mix	Assessing their products drawing on the opinions of others, using appropriate sensory descriptors Serving food attractively	Sources of fruit and vegetables Why we need them
Key Stage 2 (ages 7 - 11)	Safety and hygiene factors related to their working environment and the storage of Foods Properties of foods for energy and growth Measuring and combining starchy, sugar and dairy foods Energy sources that cook food	Evaluating consumer acceptability of their products using tests with verbal and/or pictorial scales	Sources and functions of foods for energy and growth Foods that are needed for a health eating
Key Stage 3 (ages 11 - 14)	Safety and hygiene factors related to product development The use of attribute analysis in food product development The selection, modification and use a range of recipes when making a food product Controling the quality and shelf life of a food product through knowledge of the physical and chemical properties of foods Batch production and quality control	Setting up and conducting sensory tests which produce valid and reproducible results eg attitudinal and difference tests - triangle, ranking, hedonic Understanding the need to control portion size, temperature of samples, number of people on the taste panel to standardise results	Goals for healthy eating Sources and nutritional functions of fats, proteins, carbohydrates. The use of dietary analysis to 'model' with food Links between food intake and energy Expenditure
Key Stage 4 (ages 14 - 16)	The safety, hygiene and environmental Legal Standards required for food production and distribution. Food packaging and storage Causes and control of food spoilage Controlling the shelf life, organoleptic and nutritional qualities of foods using physical and chemical preservatives. The product development process Marketing and retailing	The use of statistical data derived from different sensory tests to evaluate key characteristics of products The use of tests on key characteristics of products to specify criteria for consumer acceptability The use of tests to produce a product specification	The sources and functions of fibre, water, fats, carbohydrates, proteins, vitamins, minerals for different population groups Knowledge of simple/complex sugars, low and high biological value proteins, saturated/ polyunsaturated fats, vitamins A/B/C/D/E Effects of processing freezing/heating/ mechanical manipulation on nutrient content The use of food analysis in writing a food product specification

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(1994), Education Liaison Manager, Unilever UK, argued that industry is concerned about the availability of technological skills. He saw an urgent need for a properly trained and well motivated teaching force to deliver technology in schools. It is an exciting and demanding time for all teachers of technology, including food technology: a time to move forward and take charge of the future.

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Now you see me, now you don't! A student project designing and making a child's pop-up book

Matthew Phinn

The Hayfield School, Doncaster

Paper engineering is a popular area for GCSE Design and Technology. Matthew Phinn describes his project, which won him £250 and an Arkwright Scholarship.

For my Project Trident Work Experience I spent two weeks in a first school. I became fascinated watching the young children's reactions to the range of bright, inventive and cleverly constructed pop-up books and decided that for my GCSE Design Communication project I would design and construct a children' s pop-up picture book using paper engineering.

Research

Firstly, I researched the project carefully by visiting the public library, bookshops and the local infant school to look at the range of children' s pop-up books available. I also wrote to the main producers of the books, Child's Play International and Orchard Books, asking for information and advice.

Sadly, neither publisher replied to my letter. I had heard that the North Yorkshire Advisory and Inspection Service had produced some technique project sheets featuring pop-up books and the Design Technology Adviser kindly lent me a copy. I dismantled two pop-up books — *Small Talk* by Jan Pienkowski and *Learn about Farms* by Child's Play — to discover the different techniques they had used to create pop-up effects and found that there are four main techniques:

- Square fold — this makes the basic box shape and can be used to produce a design involving a table, bed or the base for other figures (Fig. 1)
- V fold — made from a single piece of card folded to make two triangles, this forms a basic V shape and can be used to produce a design such as a duck's beak, a crocodile, a bat or a tent (Fig. 2)
- Slider — this technique is used to make an animated card with an element of surprise. It is where a face or object appears and moves in a sliding action. Creatures can appear from behind bushes, faces pop up or objects slide into view. (Fig. 3)
- Spinner — with this technique, a disc is turned upon a pivot to reveal a hidden object, creature or word. (Fig. 4)

From my research, I came to a number of conclusions, which helped me in the specification:

- Pop-up books are directed towards the age range 4 to 8. Little children like the big, bright and unusual pictures and enjoy the surprises when animals and faces seem to lift from the page.
- The stories featured are simple, clear and printed in bold lettering. The aim is to get children to get to know simple words and phrases and enjoy a funny account.

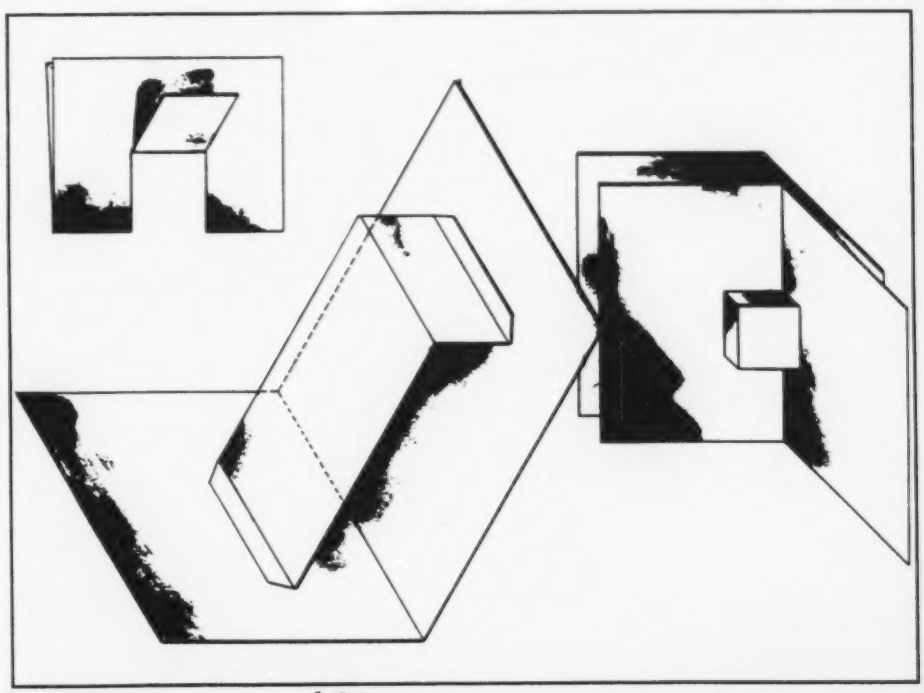

Fig.1: Square fold — this makes the basic box shape and can be used to produce a design involving a table, bed or the base for other figures.

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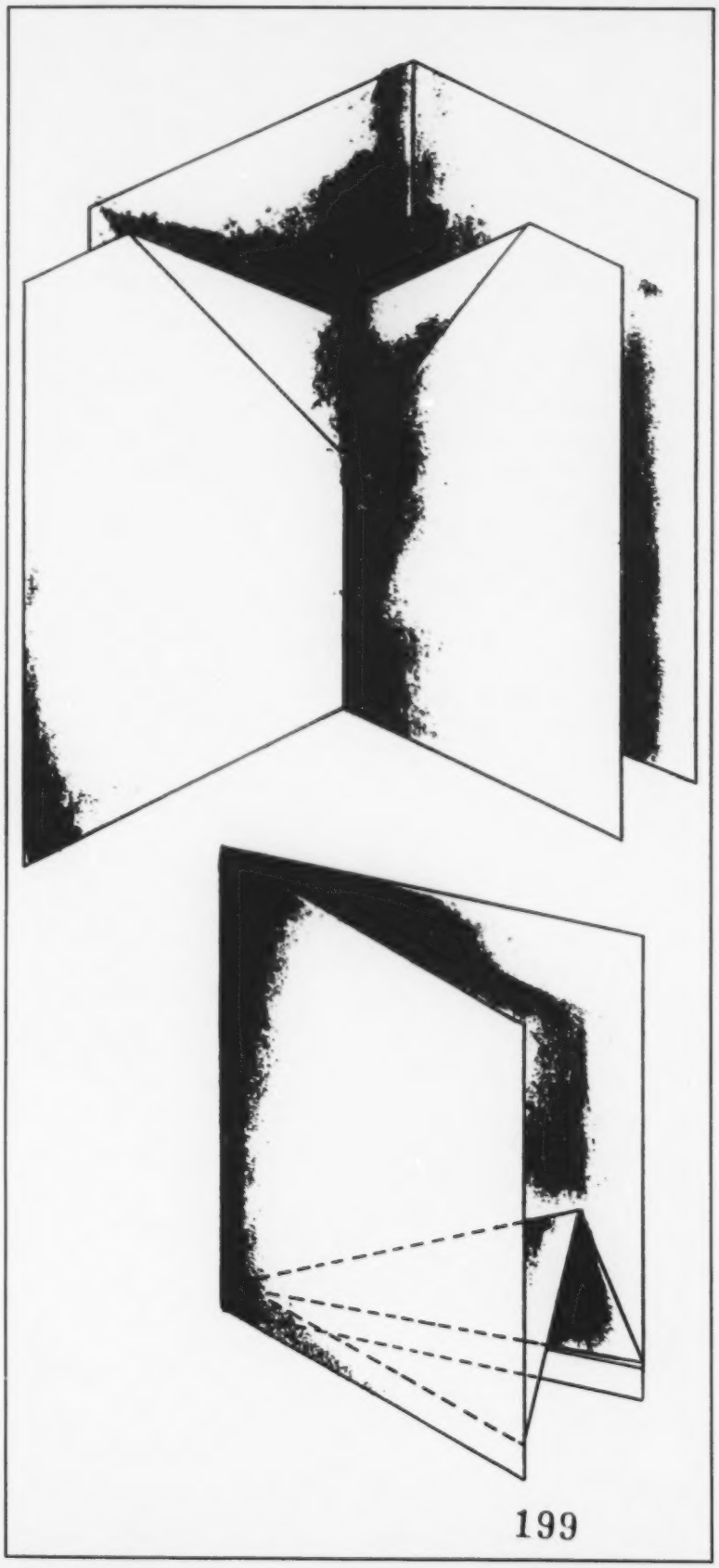

Fig. 2: V fold — made from a single piece of card folded to make two triangles, this forms a basic V shape and can be used to produce a design such as a duck's beak, a crocodile, a bat or a tent.

- The colours used are primary, bright, bold and eye-catching, with thick outlines
- The books have few pages. The majority I examined had between six and eight pages. To make a longer book would be difficult to construct and be too bulky.
- The techniques varied. The spinner and slider techniques usually appeared in the information books such as *Learn about Shapes* (written by Dot and Sly Barlow). Nick Bantock's books *Solomon Grundy* and *Jabberwocky* contained the widest variety of techniques but were intended for an older audience.

I noticed on my work experience that in the First School the children handled the books roughly, pulling and pushing at the constructions and bending the card to see what was behind. The cheap pop-up books, produced in Hungary and Czechoslovakia, fell apart easily however carefully they were handled. The books produced in Britain were constructed of thick, resistant, hard-wearing card and the pop-up mechanisms did not tear easily. In my specification I therefore decided to use strong card and a combination of the V folds and square folds.

The specification

I decided that the pop-up book would:

— contain no more than six pages (twelve sides)

— be suitable for children aged 4 to 8

— be constructed in strong but thin card

— measure 10 cm by 220 cm

— contain a range of paper engineering techniques

— contain large, simple, colourful and imaginative illustrations

— be coloured in primary colours using a range of techniques: felt-tips, gouache paints, air-brush, pastels and computer graphics

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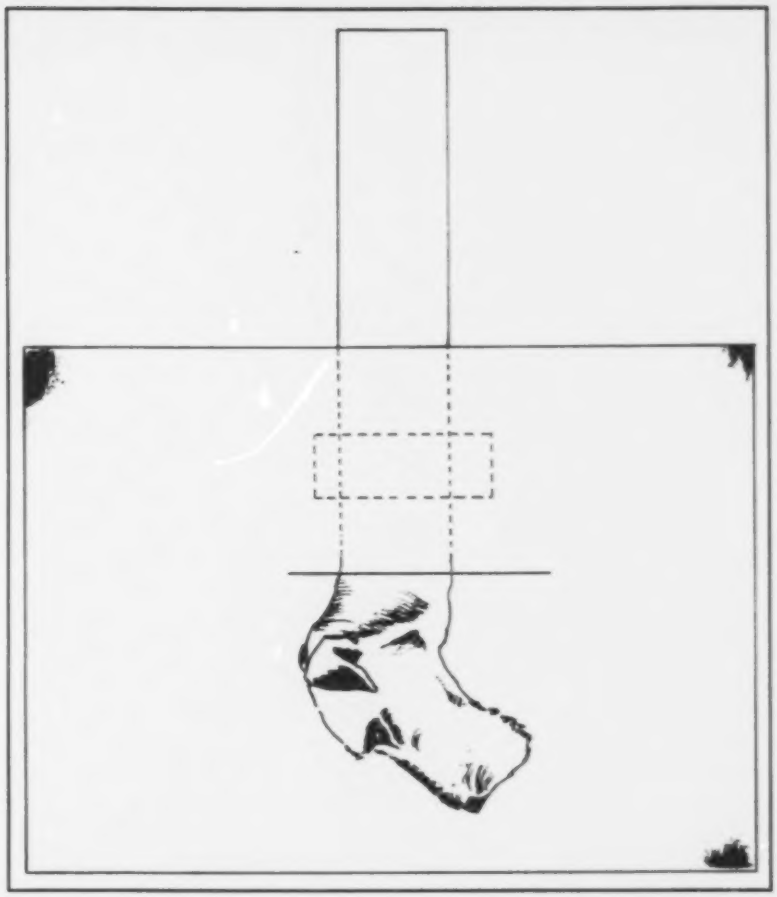
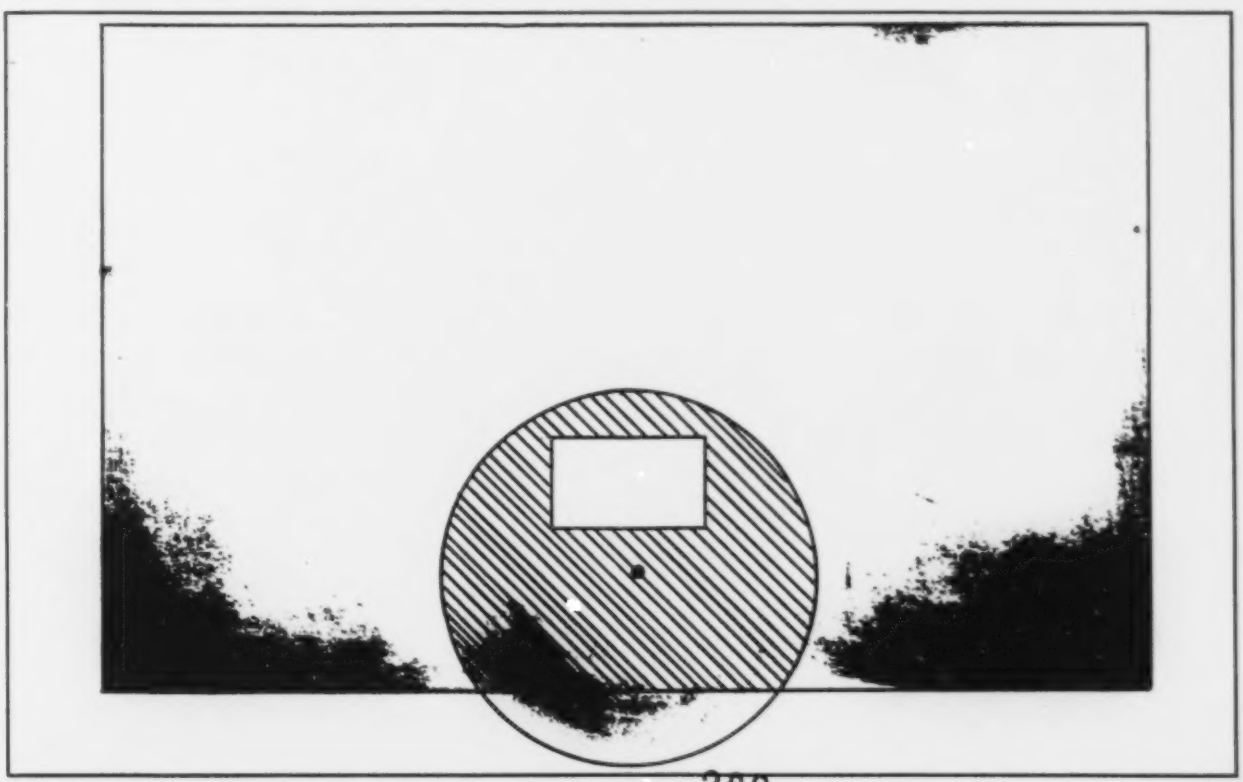


Fig. 3: Slider — this technique is used to make an animated card with an element of surprise. It is where a face or object appears and moves in a sliding action. Creatures can appear from behind bushes, faces pop up or objects slide into view.

Fig. 4: Spinner — with this technique, a disc is turned upon a pivot to reveal a hidden object, creature or word.



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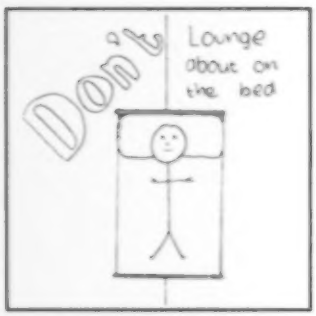

Fig. 5: Initial ideas for *Humpty Dumpty* and *Don't!*

— contain large print of various sizes but with one principal font style

— illustrate a simple story or poem which I would write myself.

Ideas

I considered a number of ideas, starting with 'Safety in the Home'. The engineering could illustrate the dangers of playing near sockets, cookers and machines, and tell children what to do in case of fire. I drew out some initial ideas, but found that the task of making pop-ups illustrating the danger of, say kettles and tools, would be too difficult.

I then considered a well known rhyme — Humpty Dumpty. Most children are familiar with this character, and I felt there would be some exciting possibilities constructing the King's horses, the falling egg and the broken shell. On further consideration, however, I decided to opt for something more original.

This was *Don't!* — a short, simple story which I would write, using a number of different paper techniques. The theme was some of the 'Don'ts' which parents are always saying to their children. The book features an angry father, telling his child:

'Don't speak with your mouth full!'
'Don't lounge about on the bed!'
'Don't squint!'
'Don't stick your tongue out!'
'Don't get into fights!'
'Don't just sit there, DO something!'

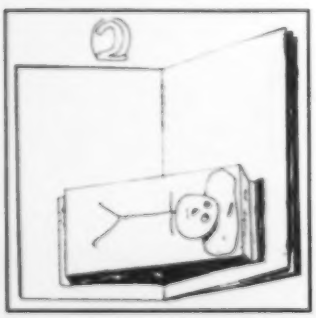

Fig. 6: An early attempt at the bed — which as Matthew found, would only work if it lay vertically across the fold.

Making

The actual construction of the book was lengthy and difficult and made me appreciate just how demanding this sort of project — which looks relatively easy — can be. Once I had finished, I tried out my story with an infant audience. The children enjoyed it but said it wasn't scary enough. My next pop-up book is to be about Dracula. Now *that* will be a challenge!

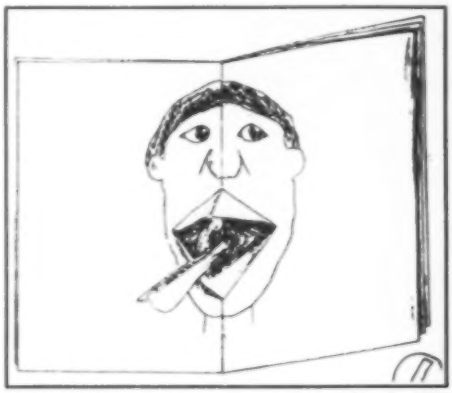

Fig. 7: Matthew wanted the whole face to spring out as well as the tongue, but modified this later so the mouth was less of a beak.

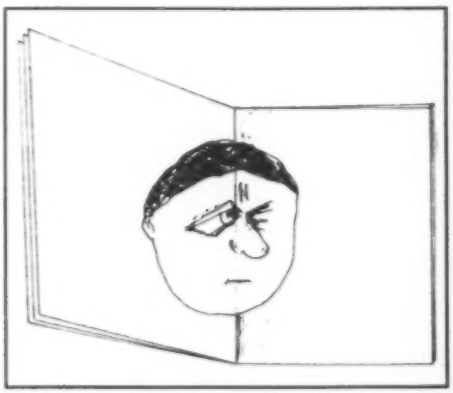

Fig. 8: With this face, it seemed better to focus on the squinting eye.

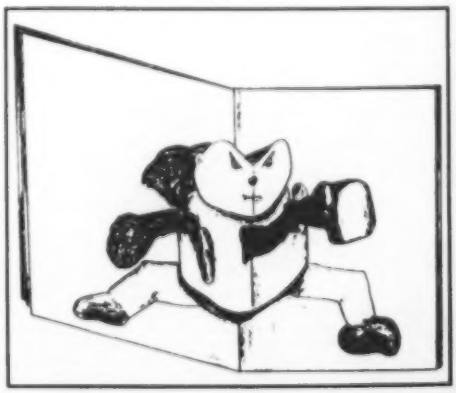

Fig. 9: Don't get into fights! This has three pop-ups: the body and the head pop up with V folds, and the arms pop up through slits in the body.

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Co-ordinating Technology in the Primary School: developing students' capabilities

Mark O'Hara and Margaret Noble

Mark O'Hara is Head of the Centre for Science Education and Margaret Noble is Subject Leader for Primary Technology Centre for Science Education, Sheffield Hallam University

Mark O'Hara and Margaret Noble wanted to find ways of helping final-year BEd. (Hons) students prepare for possible future roles as technology co-ordinators in primary schools; using a range of school- and university- based activities and the GRASP problem-solving approach, these are their findings.

Our purposes

The aim of this work was to prepare our students for their future roles as co-ordinators in primary schools. Although we do not anticipate that our students will go straight from college into such posts, we know that at some point in their future careers they are going to find themselves with curriculum responsibilities. We feel that it is therefore necessary to lay the foundations for this important role while students are still at university rather than simply expecting them to learn the job in school as they go along.

Such preparation needs to be set against the background of the report by Alexander, Rose and Woodhead which suggests that, in the past, while the development of curriculum co-ordination in schools had made quite an important impact on whole-school planning of the curriculum in general, it had had less impact in terms of effective classroom practice[1]. This is due firstly to co-ordinators having limited access to their colleagues' classrooms and secondly to the fact that the job places the co-ordinator in a contradictory position, astride two roles — one as a member of the familial group and the other as a member of the inspectorial team[2].

Our purpose was therefore to turn out a group of students who could support schools and colleagues in terms of planning for technology but who had also been given the opportunity to consider ways and means of affecting classroom practice within the constraints of the primary school. It was apparent at an early stage in our planning that we needed to provide the students with school-based experiences. The activity would require tutors and students to work closely with local primary schools. There were two issues in particular which we needed to address: the role of the co-ordinator as a researcher and the need for a process which would allow for the job to be managed efficiently and effectively.

Our criteria for a successful outcome

We wanted to be able to say, following the exercise, that the students:

- were more confident in their own abilities to work with their peers and professional colleagues
- had increased their knowledge and awareness of current thinking in terms of good practice in bringing about change and supporting development in schools
- could think in a reflective and intellectual way about their subject and its place in the curriculum — in other words, not simply act as conduits for other people's ideas but be capable of conducting their own research in schools and feed the resulting information into any debate.

As for the schools, we felt we might measure the success of the exercise against the following criteria; by the end of the project the teachers would feel:

- comfortable with groups of students conducting research in their classrooms and running short staff meetings
- that the students had contributed to the current debates about aspects of primary technology in their schools and had stimulated further discussion
- that the exercise was worthwhile and interesting.

The overall strategy

After considering a number of ways of approaching this, we decided upon a balance of both college-based input and school-based work. The outcome would require the students to take on the role of teacher as researcher[3], to assume the role of co-ordinator for a short period of time and to be placed in a situation in which the results of their research were to be fed back and shared with practising teachers.

The college-based work was to take place within two separate units which were timetabled to run side by side. The first of these dealt with the co-ordination of technology in the primary school and the second with research methods. The nature of these two fitted our purposes well and gave ample scope for integration.

Controlling the process

We also needed to identify how we were going to manage and control this process. We decided that the use of GRASP®(Getting Results And Solving Problems — Comino Foundation, 1986) would be extremely useful not only in helping us to be successful in managing the process but that it would also be a key element in preparing the students for the demands that would be made of them in schools and in the submission of work for assessment. GRASP describes an approach to learning designed to

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promote clearer understanding of the process of getting results and an increased chance of achieving clearly formulated objectives[4].

The students had been introduced to the GRASP process previously for planning various school-based activities and for effective time management. In this task GRASP would ensure that students would:

- demonstrate clear purposes for what they were doing
- identify realistic and achievable criteria against which to measure the success or otherwise of their activities
- produce a logical plan of action
- make use of a continuous and informative process of review and evaluation.

Above all, it would make use of the key feature of GRASP — one which distinguishes it from other problem-solving models — namely controlling the process, making things happen in the way one wants things to happen.

As the tutors responsible for the units and the work in schools, we too had to consider how we were going to control this process. We decided to do this by:

- discrete college-based inputs on the role of the co-ordinator and on research methods
- establishing a shared understanding of what our purposes were and what the schools wanted to get out of it
- establishing effective liaison with the schools
- using appropriate teaching and learning strategies
- managing and organising the two units in such a way as to make things happen in a planned way.

■ Our plan of action

For the school-based work we approached two local primary schools, an infant school and a junior school[5], who agreed to participate, and students worked with one or the other according to the key stage in which they had chosen to specialise. The tutors then met with the technology co-ordinators from the two schools and discussed the possible ways in which the students might best work with the staff and children. It was decided that a staff meeting taking place at the end of the day would be the best way for the students to disseminate their findings. The students then met with the co-ordinators and together with the university tutors were able to discuss the issues identified by the schools as being associated with technology education. These issues included the use and storage of resources, quality in teaching and learning, assessment, safety, differentiation and progression.

The students worked in pairs, each pair being given one of the issues identified by the schools. They then had to conduct research into this issue in order to feed back their findings to the schools. Their research was to cover three areas: to focus upon the existing and current literature, to look at what was actually happening in the two schools, and to gather information from other schools.

To enable students to do such research effectively the research unit was split into two equal sections. In the first section the students were given inputs on conducting various research methods and techniques such as conducting surveys, writing and analysing questionnaires, conducting effective interviews, systematic observation and action research. Each of these sessions was followed by one in which the students were given a directed task which focused upon a different method or technique. The task was to try out and evaluate these methods and techniques, thereby practising and improving their skills in this area. The students were able to make use of these sessions to do some research focused on the particular issues they were researching for the schools. The second section was conducted on a tutorial basis as students developed their research programmes in readiness for the feedback sessions in school. These programmes were quite varied and students were not only able to do research in the two schools in the project but also worked with other schools (many of them formerly their teaching practice schools), observing and interviewing children, interviewing staff and conducting questionnaire surveys.

While the research unit allowed the students to explore the role of the teacher as researcher and to gather information which would provide the content for the staff meetings, the unit on co-ordination allowed them to explore the role of the teacher as co-ordinator and to examine the processes by which they might disseminate the content. To achieve this the unit was also

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divided into two equal parts. The first part consisted of lectures and seminars which covered issues and areas such as OFSTED and its implications, models of curriculum organisation and delivery, the nature of change, whole-school policies, report writing, roles and strategies for working with peers and colleagues, and input on the areas defined by the schools. The second part focused on the staff meetings and was given over to meetings in which the pairs planned the INSET sessions and to tutorials at which these plans were discussed and further support given by the tutor.

Throughout the exercise it was emphasised that what was expected of the students was that they should:

— make a well researched and considered contribution to a debate that was already present in the schools — a debate concerning what constitutes good practice in technology education

— plan an appropriate dissemination session

— make use of those sessions as learning experiences to reflect upon and from which to learn lessons which would prepare them for their future roles as curriculum developers and co-ordinators.

Evaluating the exercise

Students and teachers were asked to evaluate the experience against the original criteria. Based on this feedback and from our own observations the following conclusions can be drawn:

• The students have increased in confidence. All the students are able to say that they they took part in this exercise and some are able to say that they were very successful. Even those who were less successful gained in confidence by being given the opportunity to try things out in a relatively safe environment and learn from the experience. The research element also helped to build their levels of confidence by helping them to gain a deeper understanding of aspects of their own subject.

• The feedback from students also indicates that they have increased their knowledge and awareness of what constitutes good practice in bringing about change and supporting development in schools. The school-based element was pivotal as it provided them with an opportunity to test and to apply their skills and techniques in a real situation rather than in the university setting.

• Through placing the emphasis upon the teacher as a researcher we believe we were able to inject a degree of intellectual rigour and that the use of GRASP encouraged and reinforced reflective behaviour. Not only were the students drawing on the published literature, they were also conducting classroom-based research in the light of some of that literature and combining the two to make an informed contribution to the debates current in the schools.

• The use of GRASP also helped them to achieve their desired outcomes, in carrying out the research and in disseminating the outcomes of that research. The importance of control within the process became particularly apparent to some of the students once they began to run their staff meetings and found that planning and a timetable in themselves are not sufficient but that one has to recognise the need for action and to be capable of taking action in response to the things that happen during such an activity.

• A good working relationship between the students and the schools was built up and maintained throughout the exercise and the feedback from the schools suggests that the activity was worthwhile and successful.

Plans for the future

We are convinced that as a result of student feedback, comments from the schools and our own observations, this was a very worthwhile activity. However, as a result of our own review and control of the process we are now looking for ways forward to make it even more worthwhile for schools and students.

We are now in a position to talk and to plan from experience, which will add to the quality of our planning and our support for the students and the schools. At the beginning of the units we intend to share the experiences of this group with the next cohort of students. We are also looking at the possibility of spending a day in school which will allow for students to plan and to run technology workshops with teachers and children. The day would end with a staff meeting at which the students would present their research findings and which would give time for a discussion of points and issues raised during the day.

References

1. Alexander, Rose and Woodhead, *Curriculum Organisation and Classroom Practice in Primary Schools: a Discussion Paper*, DES, 1992 pp.78,79
2. Campbell R.J., *Developing the Primary School Curriculum*, Holt Education, 1985
3. Bentley, D. and Watts, M., *Primary Science and Technology*, OUP, 1994
4. Comino Foundation, *Occasional Paper No. 3: Motivation and Achievement — The 'GRASP' Approach*, 1992
5. Dobcroft Infant School and Dobcroft Junior School, Sheffield

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Book Reviews

That's Nice!
STEP
CUP, £5.95
Reviewed by Ian McLintock

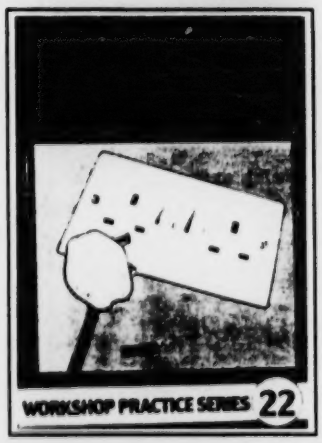
That's Nice! is a resource book in the Key Stage 3 series of the STEP 5-16 (Staffordshire Technology Education Programme) books. It has been produced as part of the overall initiative to enable teachers to deliver the existing National Curriculum.

My first impression meets the title of the book exactly — here you have a book that enables you and your pupils to establish projects with resources, produced in an easily accessible form, suitable for KS3 work in all aspects of technology. The book is divided into five sections, all targeted at delivering skills to create successful projects, through specific examples. Each section is backed up by continual references to the Data File, another of the STEP programme publications.

The first section, Creating and developing original images, looks at solving the question 'Where do new ideas come from?'. A series of colourful images and ideas are presented which could possibly motivate, but is rather too biased towards patterns and pictures.

Section two, Presenting design ideas, is much better as it puts graphic techniques into a series of project areas, such as bicycles and cycling accessories and sports and leisure equipment. It asks questions as it goes, reinforcing them with further details of the techniques used to get the results illustrated.

Modelling and prototyping, the third section, explores the range of modelling techniques available. Examples are presented through a series of projects, such as mechanisms in a Lego mock-up and the use of foam for prototyping small electrical products.



The Case studies and Design Situations follow the now established pattern, applying the ideas and skills explored earlier through specific projects. One example has already given me the background and resources to pursue a particular project I have had in mind for some time.

Throughout the book both presentation and ideas are excellent, my only reservation being the first section, which is likely to be under-used anyway with the new Orders. This is a book you should buy for your resource base even if you are not part of the STEP programme.

Workshop Electrics
Alex Weiss
Argus Books, £6.95
Reviewed by Alan Trueman

This book is intended as an aid for model engineers to plan a workshop in their home. In an educational environment it could be used as a source book for project work or for CDT teachers taking early retirement (if any still exist!) and setting up their own workshop.

The book deals with every aspect of supplying electricity to a workshop, from planning, safety, different types of supply, fuse ratings, wiring, outside wiring, plugs and sockets, lighting and low-voltage supplies.

I found the book both informative and interesting. It answered all the areas of doubt that anyone might have about electricity and I felt it would be helpful for any practical person about to set up a workshop.

This is a book that deals well with its subject and brings together a diversity of information that would be difficult to locate in several different books. An excellent book for the price, if only to reassure yourself that you have covered every eventuality.

Communicating Design
Colin Chapman & Mike Finney
Collins Educational, £6. 75
Reviewed by R. Foulger

This book is clearly designed for those in the 14 to 19 age range who are studying D&T GCSE and vocational courses.

Sections are clearly and logically set out along with the various techniques necessary (CAD/CAM included) to aid the developments of a student's design, graphic and modelling skills, and extremely well documented. The techniques are highlighted by clear case studies taken from industry and show how industry makes use of specialists and special skills to improve communication. There are a few exercises to be attempted, designed to reinforce some of the more basic techniques.

This book would appear to be most useful as a reference for the more motivated student and for those taking post-16 courses, because the various sections need to be carefully read in order to make best use of them. However, the industrial case studies are particularly useful to all students.

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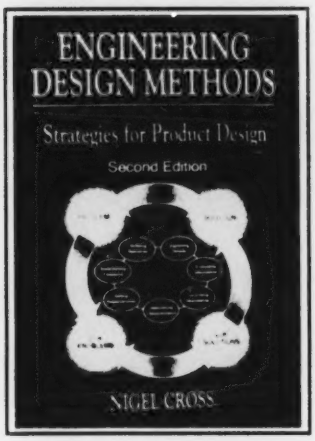
Engineering Design Methods
Nigel Cross
Wiley, £15.50
Reviewed by Chris Snell



This book outlines both general and specific techniques — from brainstorming, synectics (drawing on analogy and in a sense the reverse of brainstorming) through to value engineering and analysis, culminating in the formulation of design strategies to suit particular design problems.

The author has researched and examined British and foreign publications and has put together a useful and lucidly compiled manual of design methodology. It is interspersed with examples of real product investigations. He deals, for example, with the issue of 'ill defined' or 'ill structured' design problems, aware that a wide range of criteria might have to be satisfied, with no single objective to be satisfied above all others. In this respect, sub-solutions can be found to be interconnected with each other in ways that imply a 'pernicious' structure to the problem, i.e. a sub-solution that resolves a particular sub-problem may create irreconcilable conflicts with other sub-problems. For example, the addition of heat sinks to solve troublesome heat transfer problems in electronic components conflicts with a priority requirement to keep weight down. Research studies are then undertaken in which incompatible pairs of options are identified and sets of options then regenerated containing no incompatible pairs.

Whilst experienced designers might be mistrustful of 'over- formalised' design methodologies or fancy names for old, common-sense techniques, a counter-arguments bears repeating. That is that many design projects are too complex to be resolved satisfactorily by instinct and old, conventional methods. This is particularly so where the co-ordination of team effort is demanded in which several designers of different disciplines and specialists in other areas need to be in consultation with each other.

The book contains eleven chapters, numerous references, sources and an index. It constitutes a manual of design methods, presented in an open-learning format, and includes an Objectives tree, Morphological chart, Function analysis, Weighted objectives, Performance specification, Value engineering and Quality function deployment (Japanese technique).

Although the text is suitable for students of design and professional designers, it contains much that is relevant to National Curriculum technology. It should prove of particular use when GCSE students reach the inevitable stage of getting 'stuck' with their thinking in project work.

Space does not permit full justice to be done to this book, as it contains many useful techniques. It is a book for the technology department shelf which would not be amiss in the office of an industrial designer or a market research department involved in product promotion.

Technopacks
(Various titles, £14.95 each)
R. Ballam, L. Davies and N. Young
Technopacks (PO Box 216, Epsom, KT19 9YH)
Reviewed by Elsie Warren

These packs should prove extremely useful in departments of technology. They have been written by teachers for teachers and are aimed at Key Stages 2, 3 and 4. If you haven't yet seen them, I advise you to do so at the earliest opportunity.

I have enjoyed looking at eight of the packs, amongst them 'The Body Natural', 'Musical Textiles' and 'The Green Kitchen', all for Key Stage 3, and there are more, some of which have been featured in *Modus*. All packs are written so that teachers can be selective, picking either single lessons or groups of activities.

They are all written for mixed-ability groups and there are many obvious opportunities for extending the work. The worksheets are clear and include follow-up suggestions which encourage students to work independently. The Pupil Planners are also a bonus as they allow teachers to keep track of different levels of work and encourage students to work independently.

I am convinced that this series will be an asset for teachers looking for a creative approach to their work in D&T.

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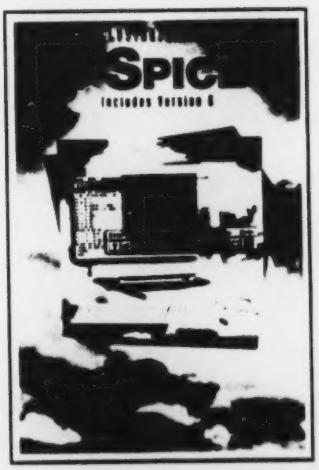
SOFTWARE REVIEW

Illustrated Guide to PSpice (book plus software)
Robert Lamey
International Thompson Publishing, £34.50
Reviewed by John Hanson

This book contains an unusual and pleasant experience: the software you need to use it comes free with the book. But before you all run out to try to get something for nothing (as I would) let me explain a little more about both book and program. PSpice is a computer simulation of analogue electronic circuitry. In its original form, SPICE (Simulation Program with Integrated Circuit Emphasis) it was developed at the University of California, Berkeley, for engineering students to use on mainframes and VAX mini-computers.

PSpice in a PC version produced by the MicroSim Corporation for engineers and students ($1000+) and what you get is a stripped-down evaluation version distributed free and using many fewer components (a maximum of ten transistors) and a much smaller library of components. Despite this, it is still very usable as a teaching tool and for design and practice by students.

I think it would fit in well at colleges or university level or in specific electronics courses post 16. The subject matter includes many things that could fit into A level physics and technology: transformer circuits, diodes, half wave rectifiers, op amps, etc., but the detail and knowledge available in this material is much more than would normally be needed. The package would also be very useful to the electronics hobbyist and other interested individuals who are effectively self-taught (I was born in the year William Shockley developed the first workable transistor, and it was a lot longer ago than you might think!) and wish to improve their knowledge.



The software loads easily and works well. It has a Windows-like editor page which is easily used but is not as wimpish (sorry) as most new PC software, as you create and edit small program files to provide the software with the data about the circuit you want to model and about the sorts of output you want. It requires a little knowledge and confidence with your computer, but the book takes you through it step by step with a superb, patient and clear style. The contents will be familiar to most people with some electronics knowledge but the latter — and I hope more difficult — parts of the book on Field Effect transistors and Colpitts Oscillators (?) certainly stretched my knowledge of electronics.

I have spent some time working through parts of the book. Whilst it's not for the electronically ignorant or the computer phobic, I found it immensely enjoyable and very informative. The graphs are great, the text is helpful, the suggested programs work and I could feel my knowledge being extended. This is a superb book for engineering or physics undergraduates and anyone interested in the detail and theory of electronics, and if I were teaching this sort of subject matter in further or higher education, I would be exploring it with a view to using it for supported self-study. I can recommend it as something which, although not easy, is worth while.

GIRLS AS CONSTRUCTORS IN THE EARLY YEARS
Promoting equal opportunities in maths, science and technology
Carol Ross and Naima Browne
In National Curriculum science, mathematics and technology, girls are consistently outperformed by boys. This handbook sets out ways of involving girls in constructional activities from the start of schooling and analyses the management issues that determine their achievement.
'...looks at why girls use construction toys less often and less creatively than boys, and suggests practical ways which can help teachers to redress the balance'
— The Big Paper
1994, ISBN 1 85856 002 0, Price £7.95,
64 pages, 210mm x 210mm

MAKING THE PLAYGROUND
A Key Stage 2 project in Technology, Art, English and Mathematics
Elleen Adams
This book reports on the work of pupils at Gillespie Primary School in Islington to improve the quality of their school environment. As well as its mathematical and science content the work satisfies the requirements of the new attainment targets for Design Technology in the National Curriculum at key stage 2. Truly, design education in action in the development of schools grounds!
'Useful advice for teachers who might be thinking of embarking on similar schemes.'
— Design and Technology Times
1993, ISBN 0 948080 92 2
Price £6.95, 56 pages, 210mm x 210mm

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Guidance to Contributors

In order to provide some guidance for those who may wish to send in contributions, but are not sure if what they have is appropriate, an outline of the general requirements of articles for the journal and the particular feature of the sections are outlined below.

General

In general all contributions should be double line spaced where possible.

We can not take responsibility for those which may go astray in the post so please retain a copy yourself.

Articles can be of varying length and should identify with a particular audience e.g. teachers, HE-researchers or students, developers.

Inclusion of the following, where appropriate, would be most helpful to the editor and the reader:

- The name and title of author together with a contact and telephone number for the editor. In addition if you would welcome contact from readers please include a correspondence address.
- Full reference: title, author or editor, year, publisher. For Journals the title, volume no. and title of article.
- Illustrations; if taken from somewhere else please state if permission to reproduce has been gained, if not then from whom it may be gained. Other illustrations such as photos, planning sheets, pupils' work, etc. should be as clear as possible and enhance the article.
- A short paragraph, about 100 words, at the beginning of the article which describes what the article is about; follow by paragraphs which have sub-headings.

Contributions are welcomed to particular sections:

Personal perspectives

These should be short, about 1000 words, giving your views on D&T issues.

Letters

Letters too should be short and punchy. If in response to an article or letter, etc. this should be clearly referenced.

Resources

Reviews on how resources are used in the classroom to support and enhance D&T. These may include equipment, software, a curriculum packs, people and other organisations, etc.

News and notes

Information on conferences, events, initiatives, situations vacant etc.

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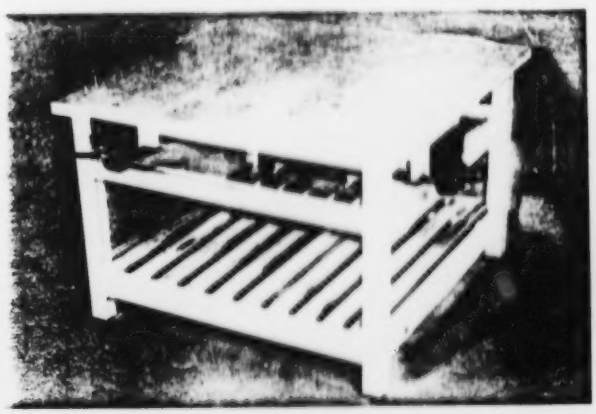
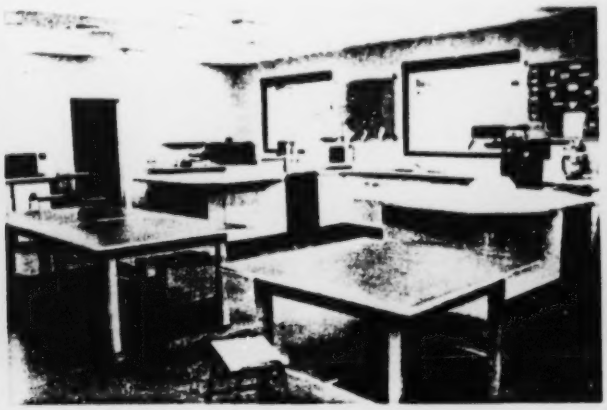

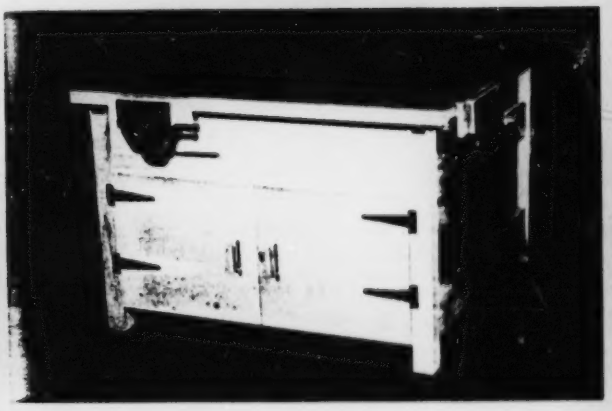

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